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MELBOURNE



# NUTRITION AND REPRODUCTION IN THE AUSTRALIAN SHEEP BLOWFLY *LUCILIA CUPRINA*

By L. G. WEBBER\*

[Manuscript received June 4, 1958]

## Summary

Carbohydrate, protein, and salts are essential for the development of eggs by *Lucilia cuprina* (Wied.). In the presence of sucrose, each of the following is adequate for egg development: casein, milk, yeast, egg albumen, and gelatin plus L-tryptophan. However, egg development on these foods is slower than on liver. Contrary to previous findings, it is shown that sheep droppings may provide adequate food for the development of eggs in *L. cuprina*, especially droppings from sheep on improved pastures during spring and autumn, when both pasture and faeces have a relatively high protein content.

## I. INTRODUCTION

Mackerras (1933), Evans (1935), and Hobson (1938) demonstrated that protein was essential for the development of eggs of *Lucilia sericata* (Meig.). However, these investigations were not designed to assess the role of individual amino acids or, indeed, whether other factors than amino acids were also required. A more detailed study of the food requirements of *L. cuprina* (Wied.) for egg development seemed warranted. While this study was in progress Rasso and Fraenkel (1954) and Harlow (1956) reported their investigations on *Phormia regina* (Meig.) and *Protophormia terrae-novae* (R.D.) which are in close agreement with those reported below for *L. cuprina*.

The necessity of a protein meal for the maturation of the eggs of the blowfly raises the question, important for our understanding of the biology of the Australian sheep blowfly (*L. cuprina*), of the source of such protein meals under natural conditions. It was observed by Gilmour, Waterhouse, and McIntyre (1946) and Norris (unpublished data) that flies released in the field 2 days after emergence, without a feed of protein, had mature eggs 2 days later. The immediate source of protein was not obvious, since, under the usual field conditions of fairly high temperature and low humidity, it would be expected that the occasional bird or mammal carcass would not provide a suitable supply of blowfly food for more than a few days. Other possible sources of protein are considered in this paper.

## II. METHODS

Duplicate batches of 20 adult female *L. cuprina* were kept in cages 9 by 6.5 by 6.5 in. at 25°C and 40 per cent. R.H., and uniformly illuminated for 9 hr each day. The experimental foods (proteins, sucrose, and salts) were intimately mixed in

\*Division of Entomology, C.S.I.R.O., Canberra; present address: I.C.I.A.N.Z. Ltd., 363 Adelaide St., Brisbane.

the dry state with a mortar and pestle. Preliminary experiments showed that dry food could not be utilized by the flies, so in all the experiments reported below, the food was made into a slurry and kept moist by frequent addition of distilled water. Ovaries were examined on the third day for egg development. If there was little or no development the experiment was continued for a further 5 days.

### III. RESULTS AND DISCUSSION OF LABORATORY STUDIES

#### (a) *Effect of Specific Foods on the Maturation of Eggs*

##### (i) *Proteins*

Flies had fully developed eggs in:

- (1) 3 days when fed sheep liver with or without sucrose.
- (2) 4-5 days when fed fat- and vitamin-free casein (Labco or B.D.H.) together with sucrose and salts (Hubble's salts, Table 1).

TABLE 1  
COMPOSITION OF HUBBLE'S SALTS

Compound	Parts per Thousand	Compound	Parts per Thousand
Calcium carbonate	543	Ferric phosphate	20.5
Magnesium sulphate	16	Potassium iodide	0.008
Magnesium carbonate	25	Manganese sulphate	0.35
Sodium chloride	69	Sodium fluoride	1.0
Potassium chloride	112	Aluminium potassium sulphate	0.17
Potassium dihydrogen phosphate	212	Copper sulphate	0.9

- (3) 8 days when fed the 10 "essential" amino acids (see Section III(b)) in the same ratio in which they occur in casein, plus sucrose and salts.
- (4) 5-6 days when fed on baker's yeast alone. The addition of sucrose only, or sucrose and salts, gave full egg development in 4 days.
- (5) 5 days when fed on whole cow's milk and sucrose.
- (6) 5-6 days when fed on gelatin, L-tryptophan, sucrose, and salts. However, flies were unable to develop eggs when L-tryptophan was omitted from this diet.

Egg albumen proved to be very toxic to flies, although the development of eggs was well advanced in the few females still surviving at 3 days. Its toxicity may have been due to the presence of the protein avidin which has the capacity of binding biotin, so making this B-complex vitamin unavailable to the fly. Biotin is essential for the growth of most insects, although its role in adult survival has not yet been investigated.

##### (ii) *Carbohydrates*

Flies fed on casein, Hubble's salts, and water survived for about 8 days, but there was no egg development. Carbohydrate is therefore required to enable the



fly to utilize dietary protein for the maturation of eggs. On water alone *L. cuprina* adults live for about 2 days. *L. cuprina* is thus capable of using protein as an energy source for survival, but not for the dual processes of survival and egg production. This result is in accord with the essential role of carbohydrates as an energy source for synthetic processes in higher animals (Munro 1951).

### (iii) *Inorganic Salts*

When Labco casein was used as a protein source, magnesium carbonate (B.D.H. laboratory reagent) was the only additional salt necessary for egg maturation. When B.D.H. (fat-free and vitamin-free) casein was used, calcium carbonate (B.D.H. "Analar") as well as magnesium carbonate had to be added. However, since spectroscopic analyses of the two casein samples (Table 2) showed 14 mineral elements to be present in considerable quantities any detailed study of the minerals necessary for egg production was beyond the practicable scope of the present study.

TABLE 2

COMPARATIVE CONCENTRATIONS, ACCORDING TO SPECTROCHEMICAL ANALYSIS AND VISUAL EVALUATION OF SPECTROGRAMS, OF ELEMENTS DETECTABLE IN THE TWO CASEIN SAMPLES

Concentrations are in arbitrary units and are corrected for ash content

Element	B.D.H. Casein	Labco Casein	Element	B.D.H. Casein	Labco Casein
P	3	2	Ca	20	1
Si	3	2	Cu	2	1
Mn	1	4	Zn	1	2
Mg	1	1	Na	2	1
Al	2	1	Ti	1	2
Fe	3	2	Sn*	50	1
			Pb	1	1

\*The relatively high concentration in the B.D.H. sample is probably due to contamination from a tinplate container.

### (iv) *Accessory Food Factors*

Halivol (Parke Davis) was used as a readily available source of sterols. It was found to be of no advantage for egg production when added to the medium of casein, salts, and sucrose. As these experiments were carried out under non-sterile conditions, the absence of any requirements for sterols for egg production is probably not significant.

### (b) *Discussion*

The above data show that *L. cuprina* females can mature eggs when fed carbohydrate and a suitable protein other than meat. Their ability to mature eggs on casein as the protein source is not unexpected, since casein contains 19 amino acids, including the 10 essential for normal growth of the flour beetle *Tribolium confusum* Duv. (Lemonde and Bernard 1951), the rat (Rose 1938), the mouse (Maddy and Elvehjem 1949), and the ciliate protozoan *Tetrahymena* (Kidder and Dewey 1949).

These 10 essential amino acids are arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. The importance of each of these amino acids was not studied, but it is apparent from the feeding results with gelatin, which is deficient in tryptophan, that tryptophan at least, is essential for egg development.

Egg development on all the synthetic diets studied was much slower than on liver, indicating a deficiency of important dietary factors. The fact that both carbohydrate and protein are necessary for egg development had not previously been reported for this species. It will be seen from the next section that this finding is of importance in considering the natural sources of food of *L. cuprina*.

#### IV. NATURAL FOOD RESOURCES OF *L. CUPRINA*

The availability of protein in the field to *L. cuprina* females must undoubtedly be a very important factor in relation to the population of gravid females and hence to the potential for blowfly strike on sheep. It is difficult to believe, after a close

TABLE 3

SPECIES OF PLANTS THE FLOWERS OF WHICH WERE OFFERED AS A SOURCE OF PROTEIN TO ADULT FEMALE *L. CUPRINA*

Common Name	Botanical Name	Common Name	Botanical Name
Aster	<i>Callistephus chinensis</i> Nees	Petunia	<i>Petunia hybrida</i>
Australian blackthorn	<i>Bursaria spinosa</i> Cav.	Red clover	<i>Trifolium pratense</i> L.
Carrot	<i>Daucus carota</i> L.	Rose	<i>Rosa</i> sp.
Convolvulus	<i>Convolvulus</i> sp.	Spear thistle	<i>Cirsium lanceolatum</i> L.
Dandelion	<i>Taraxacum officinale</i> Weber	Snapdragon	<i>Antirrhinum orontium</i> L.
Eucalypt	<i>Eucalyptus blakelyi</i> Maid.	Tree tobacco	<i>Nicotiana glauca</i> Graham
	<i>E. melliodora</i> A. Cunn.	White clover	<i>Trifolium repens</i> L.
	<i>E. macrorrhyncha</i> F. Muell.	Wild mustard	<i>Brassica adpressa</i> Boiss.
Fuchsia	<i>Eremophila maculata</i> F. Muell.	Zinnia	<i>Zinnia</i> sp.
Marigold	<i>Calendula</i> sp.	Japanese spindle tree	<i>Euonymus japonicus</i> L.

study of the food available to *L. cuprina* in the field, that there are sufficient mammal or bird carcasses to provide the sole source of protein for egg maturation. That protein is readily available to *L. cuprina* can be seen from the experiments of Gilmour, Waterhouse, and McIntyre (1946) and Norris (unpublished data), mentioned earlier. An investigation was therefore carried out on sources of protein other than carrion that *L. cuprina* could utilize for the maturation of eggs.

##### (a) Pollen

Batches of 10 laboratory-bred females of *L. cuprina* were given water and sugar and access in different experiments to flowers of 18 different species of plants (Table 3). The stalks were placed in small jars containing water. In no instance was there any formation of eggs, indicating that the flies are unable to utilize pollen from these flowers as a source of protein for egg maturation.



(b) *Sheep Faeces*

Mackerras (1933) reported that sheep droppings did not provide the proteins necessary for egg maturation in *Lucilia* spp. However, studies conducted over two years have shown that the amount of protein in sheep droppings is related to the amount of protein available to the sheep. It has long been known amongst farmers that the paddocks with the most lush growth of feed are those where blowfly strike is most severe (Tillyard and Seddon 1933). This could be due to the fact that sheep scour more easily on this type of pasture, but the results of the experiments described below show that it could also be due to the ready availability of protein in the sheep droppings. There are, in normal seasons in Canberra, two waves of blowfly strike, one in the spring and one in the autumn. These coincide with the periods when the

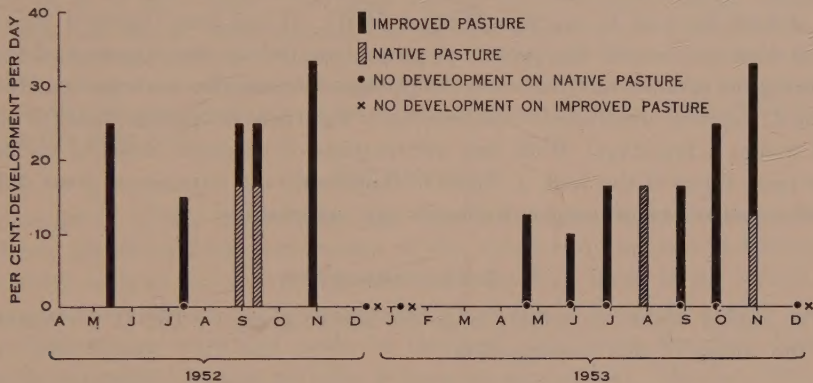


Fig. 1.—Seasonal variations in rate of egg development of *L. cuprina* females fed on fresh droppings of sheep grazing on native and improved pastures.

grass growth is the most lush, following spring and autumn rains. Faeces were collected from sheep grazing on improved pastures of phalaris and clover, and on pastures of native grass. These faeces were brought into the laboratory and offered at the same time as sugar and water to newly emerged flies. It can be seen from Figure 1 that:

- (i) female *L. cuprina* were able to develop eggs when fed for 2–3 days on sheep droppings collected in spring or autumn;
- (ii) the rate of egg maturation on droppings from sheep feeding on phalaris and clover was much greater than on droppings from those feeding on native pastures;
- (iii) flies were unable to mature eggs on sheep droppings during summer (from about the end of November until autumn).

(c) *Faeces of Other Animals*

Dissection of trapped wild flies in spring and autumn showed that the gut and crop were full of animal faeces. As well as sheep droppings, in a single experiment in the spring, the excreta of the horse, cow, rabbit, and fowl were also adequate sources of protein for development of eggs. There is little doubt therefore of the importance of the faeces of grazing animals as sources of protein for *L. cuprina* females.

(d) *Other Protein Sources*

Both the mucus of snails and homogenized phalaris or clover leaves are an adequate source of food for egg maturation in *L. cuprina*.

(e) *Honeydew*

*L. cuprina* females which were fed solely on the honeydews produced by two coccids (*Eriococcus coriaceus* Mask., *Eriococcus* sp.) and a psyllid (*Spondylaspis eucalypti* (Dobs.)) were unable to develop eggs. However, eggs were developed in two experiments each with 10 females having access to water and the honeydew of the aphid *Hyalopterus arundinis* (F.) which was feeding on *Phragmites communis* L.

It has been shown that coccid and psyllid honeydew serves naturally as a source of food for wild *L. cuprina* (Webber 1957). It has been reported above that this food does not provide the protein requirements for the development of eggs and that, during the summer months, sheep droppings alone are also inadequate. However, if female *L. cuprina* are offered both honeydew and these droppings, mature eggs are formed within a few days. With this information, it becomes easier to understand how, at most times of the year, *L. cuprina* females do not experience great difficulty in locating sources of proteins suitable for egg maturation.

## V. ACKNOWLEDGMENT

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# A COMPARATIVE STUDY OF LIPOMATOSIS IN THE SALIVARY GLANDS OF MAMMALS WITH SPECIAL REFERENCE TO THE ECHIDNA

By R. TUCKER\*

[Manuscript received May 19, 1958]

## Summary

The occurrence, site, and morphology of lipomatic changes in the salivary glands of the pig, sheep, cattle, horse, dog, goat, rhesus monkey, guinea pig, bandicoot, rabbit, and the echidna were investigated, special attention being given to the glands of the echidna. The areal, tubular, acinar, marginal, central, interlobular, peritubular, paratrabeular, and capsular accumulations were described. It was concluded that lipomatic changes in the salivary glands are of two distinctly different types, one being the formation of fatty cells from the cells of the connective tissue and the other being the partial or complete transformation of the glandular cells into fatty cells.

## I. INTRODUCTION

Yamaguchi (1924) investigated the relations in health and disease between the salivary glands and the metabolism of the whole body in man and found that the secretory cells of the salivary glands and especially those of the submaxillary gland may accumulate minute fatty granules which can be shown by special methods. Similar observations were also made by Hamperl (1931) who described these also in man as lipomatic changes and the process as lipomatosis. On the other hand, it is known that accumulations of fat in the salivary glands may be very pronounced.

Fatty transformations in the salivary glands may be connected with the synthetic and storage processes within the salivary glands, or with the occurrence of connective tissue cells between the secretory epithelia of the salivary glands, the latter being a known source of production of fat. The replacement of the secretory cells of the salivary glands by fat was interpreted by Andrew (1944) as a senile change, and he found that this transformation was common in salivary glands of aged rats. Yamaguchi thought that lipomatosis was due to a markedly pathologic metabolism of the whole body, while Hamperl was of the opinion that lipomatosis is a transformation peculiar to the organ itself.

Comparative studies of any aspect of lipomatosis are especially scarce. Accordingly, this study was undertaken to obtain data about the occurrence, site, morphology, and some directly traceable consequences of lipomatosis in the salivary glands of mammals on a broad basis.

## II. MATERIALS AND METHODS

The salivary glands of 45 cattle, 40 sheep, 16 pigs, 9 horses, 20 dogs, 4 goats, 3 monkeys, 11 guinea pigs, 8 bandicoots (*Thylacis obesula*), 8 rabbits, and 4 echidnas were investigated for lipomatic changes and lymphatic infiltrations. Their ages varied and are given in the footnote to Table 1.

\* Department of Veterinary Anatomy and Parasitology, University of Queensland, Brisbane.

TABLE 1  
TYPES OF LIPOMATOSIS PRESENT IN VARIOUS MAMMALS

P = parotid gland; S = submaxillary gland; +, positive finding; blank spaces indicate that findings were negative

Type of Lipomatosis	Echidna (a)		Bandicoot (b)		Cattle (c)		Goat (d)		Sheep (e)		Dog (f)		Pig (g)		Guinea Pig (h)		Horse (i)		Monkey (j)		Rabbit (k)	
	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S
Parenchymal																						
Disseminate																						
Areal			+			+c <sup>1</sup>		+		+e <sup>1</sup>												
Tubular	+						+d <sup>1</sup>		+													
Acinar							+d <sup>1</sup>		+													
Marginal	+																					
Central																						
Associated with connective tissue																						
Interlobular	+		+			+																
Peritubular	+		+			+																
Paratrabeccular																						
Capsular	+		+			+c <sup>1</sup>		+														

(a) All animals investigated were adults with well-developed panniculus adiposus (echidnas have an inclination towards obesity).

(b) All animals investigated were young adults. In three cases lipomatosis was very pronounced.

(c) All animals investigated were young, the oldest being 18 months, and all showed slight lipomatic changes; c<sup>1</sup>, in one case of a 12-month-old calf; c<sup>2</sup>, in one case of a 2-month-old calf.

(d) All animals investigated were young, the oldest being a 14-month-old male pseudohermaphrodite; d<sup>1</sup>, in one case of a male pseudohermaphrodite.

(e) All animals investigated were about 8 years old and there were many cases of pronounced lipomatosis; e<sup>1</sup>, in one case connected with lymphocytic infiltration.

(f) All animals investigated were adult (3-8 yr old); f<sup>1</sup>, one case of very pronounced lipomatosis with the complete destruction of acini; f<sup>2</sup>, in two cases where animals killed by intravenous injection of copper sulphate.

(g) All animals investigated were about 6-8 months old and in 40 per cent. of cases lipomatosis was pronounced; g<sup>1</sup>, in one case connected with lymphocytic infiltration.

(h) All animals investigated were about 1 year old, and in four cases the lipomatosis was extremely well pronounced; h<sup>1</sup>, in one case connected with lymphocytic infiltration of the gland and general alopecia; h<sup>2</sup>, in one case connected with lymphocytic infiltration of the gland; h<sup>3</sup>, in one case of a foetus with lymphomatosis of the gland.

(i) All animals investigated were aged about 15 years or more; i<sup>1</sup>, one case connected with slight lymphocytic infiltration.

(j) All animals investigated were senile; j<sup>1</sup>, lymphocytic infiltration of the submaxillary gland; j<sup>2</sup>, death from gastroenteritis.

(k) All animals investigated were adult; k<sup>1</sup>, one case connected with lymphocytic infiltration (rabbit killed by subcutaneous injection of 5 ml 2 per cent. copper sulphate); k<sup>2</sup>, rabbit killed by subcutaneous injection of 5 ml 2 per cent. copper sulphate.



The cattle and pigs were killed at the abattoirs, the goats were electrocuted, and the sheep and horses were anaesthetized with nembutal and bled to death. Dogs were killed by injections of nembutal or copper sulphate, and the echidnas and bandicoots were killed with carbon dioxide shortly after capture as also were the rabbits and guinea pigs (laboratory animals). Monkeys which had been sent to the Veterinary School Clinic from the Botanical Gardens for treatment had died and salivary glands from these animals were also used.

All tissues were fixed in 10 per cent. formalin or Zenker's solution (the latter for Masson's staining technique) immediately after death. When fixed, cubes of tissue of side *c.* 0.5 cm were taken from the gland for sectioning.

Paraffin sections (5–7  $\mu$  thick) were stained with iron haematoxylin and according to both the Masson and the Gallego staining techniques. Distribution of the lipomatic aggregations and their morphology is shown equally well with all staining techniques. However, Masson's staining technique is superior to the others in showing the degree of cytoplasmic condensation, while the iron haematoxylin stain has an advantage in demonstrating clearly the nuclear details.

Pycnosis, when referred to, is more pronounced in the lipomatic areas in contrast to the other regions of the section.

### III. TYPES AND LOCATION OF LIPOMATIC CHANGES

The appearance of lipomatosis is rather characteristic for various locations within the salivary glands and accordingly they have been described as parenchymal lipomatoses and as lipomatoses associated with the connective tissue (Table 1). Parenchymal lipomatosis is a lipomatosis affecting the parenchyme of the gland irrespective of the site and area covered, and may be divided into disseminate, areal, tubular, acinar, marginal, and central types (Table 1); in disseminate lipomatosis, foci of fatty material are dispersed through the whole glandular parenchyme; areal lipomatosis affects many cells in a certain glandular area simultaneously; tubular lipomatosis is a rare form of adipose change which affects the tubules of the gland; acinar lipomatosis appears as an island of fatty change, covering one or a few acini, and is markedly different to areal lipomatosis; marginal lipomatosis is confined to the margin of the glandular lobules, while central lipomatosis is always situated in the central part of the lobules.

Lipomatoses associated with the connective tissue may be divided into interlobular, peritubular, paratrabeular, and capsular types (Table 1). Interlobular lipomatosis affects the interlobular connective tissue trabeculae, capsular lipomatosis is confined to the fibrous capsule of the gland, peritubular lipomatosis develops in close proximity to the thin layer of connective tissue around the tubules, whilst paratrabeular lipomatosis affects the marginal or apical parts of the lobules in direct contact with that connective tissue which forms the interlobular trabeculae.

Each of the abovementioned types of lipomatosis causes specific damage to the glandular parenchyme and affects specific secretory functions.

## IV. LIPOMATIC CHANGES IN THE GLANDS OF THE VARIOUS SPECIES EXAMINED

(a) *Parenchymal Changes in the Parotid Gland of the Echidna*

The glands of the echidna proved to be excellent material for studying transformations within the affected cells and alveoli, various types of fatty changes being observed. All glands investigated were those of adult animals, and lipomatic changes were most common and most pronounced in the parotid. Usually lipomatic changes affect a number of closely situated alveoli which form regular spherical structures (Plate 1, Fig. 1).

Changes in the cytoplasm and nuclei of the alveolar cells depend upon the duration of the lipomatosis and the direct relation between the mass of fatty cells and the parenchymatous cells in the alveolus. When lipomatosis develops in the marginal part of the alveolus (Plate 1, Fig. 1, *a*), it causes the diminution of the productive alveolar cytoplasm and translocation of the nuclei: the infranuclear part of the cells is destroyed and, as it is in this part that ergastoplasm and secretory granules first appear, secretion ceases. Furthermore, the whole cell loses its connection with the basal membrane and is pushed towards the lumen, resulting in the compression and diminution of the lumen (Plate 1, Fig. 1, *f*). This, in turn, obstructs the flow of secretion and reduces the usefulness of the rest of the still-unaffected cells within the alveolus (Plate 1, Fig. 1, *e*).

The more accentuated accumulation of fatty globules (Plate 1, Fig. 1, *b*), especially in the central part of the alveolus, destroys the lumen directly and pushes the remnants of the cytoplasm towards the periphery of the alveolus. The compressed cytoplasm becomes dense and stains characteristically dark with Masson's stain (Plate 1, Fig. 1, *c*). Various stages of compression of the cytoplasm, from lightly staining to dark areas can be seen, the latter being confined to the paranuclear areas. Nuclei last longer than the other parts of cells, but when the ratio of nucleus to cytoplasm is greatly changed, they become pycnotic. As lipomatosis progresses, the layer of myoepithelial cells, which become disordered and mixed with the nuclei of the glandular cells, is finally destroyed. All the remaining nuclei are pycnotic (Plate 1, Fig. 1, *d*). The surrounding alveoli are subjected to the constantly growing pressure of lipomatic alveoli and are characteristically deformed (Plate 1, Fig. 1, *g*). The same is true for tubules if they are situated in the neighbourhood of this type of lipomatosis (Plate 1, Fig. 1, *h*).

The behaviour of nuclei in various types of lipomatosis is rather similar (Plate 1, Figs. 2 and 3). They usually last longer than the cytoplasm and aggregations of pycnotic nuclei or their remnants can be observed, even in completely destroyed alveoli. In cases of marginal alveolar lipomatosis the pycnotic nuclei may contact each other, giving an appearance of a nuclear barrier at the marginal part of the alveolar cytoplasm (Plate 1, Figs. 2, *c*, and 3, *a*). In Plate 1, Figure 3, *c*, changes in the nuclei in the marginal strip of parenchymatous cells and their relation to the amount of cytoplasm present in the alveolus can be observed. Here, nuclei exposed to direct pressure are all pycnotic. Others exhibit more or less pronounced changes according to the larger or smaller amount of protoplasm in their surroundings.

Myoepithelial cells most often persist even after the destruction of the whole alveolus (Plate 1, Fig. 2, *d*). However, if lipomatic changes occur in two neighbouring



alveoli, adjacent myoepithelial cells become initially translocated and separated from each other (Plate 1, Fig. 2, *d*) and subsequently destroyed.

Lipomatic changes which move across a number of alveoli without the previous complete destruction of one whole alveolus (Plate 1, Fig. 4, *a*) were also seen. In such cases the nuclear barrier may become very long (Plate 1, Fig. 4, *b*). In this areal lipomatosis all lumina in an acinus may become closed or destroyed. In Plate 1, Figure 4, *d*, the last active lumen in the acinus, which originally contained five, is shown.

Usually in areal lipomatosis several alveoli are affected simultaneously but initial accumulations of fat are not connected with each other, which results in many alveoli only partially functioning.

(*b*) *Parenchymal Lipomatoses in the Salivary Glands of the Monkey, Rabbit, and Guinea Pig (Table 1)*

A disseminate type of lipomatosis was observed in the submaxillary of an old rhesus monkey, where spherical or square-shaped lipomatic accumulations were dispersed throughout the whole glandular parenchyme. In this type of lipomatosis the destruction of single cells and alveoli is not so pronounced as in previously described forms.

In the parotid of the rabbit the formation of the nuclear barrier and the darkening and increasing density of cytoplasm were not observed. Some isolated light nuclei were visible within the fatty accumulation, but the surrounding parenchyma had not changed much. Progressive lipomatosis of this type may result in the insulation of a small amount of parenchymatous tissues. In these cases the lipomatic reaction of the peripheral parenchymatous tissue on these isolated islands seems completely different from that in previously described types of lipomatosis. Cytoplasmic density is not increased much, and nuclear barriers are not found. In the central part of one island, small alveoli with dark nuclei remained while the periphery of the island had lightly stained protoplasm without nuclei which, however, was not greatly affected by the fatty granules.

In the sublingual gland of the guinea pig (Plate 2, Fig. 1), changes of parenchymatous tissue are even less pronounced than in the mucous cells. The tubules and alveoli disintegrate on the periphery and the central part of the island consists of fully preserved glandular units (Plate 2, Fig. 1, *a*).

(*c*) *Lipomatosis Associated with Connective Tissue (Table 1)*

In paratrabeular lipomatosis, usually the lobules situated on the other side of the trabecula are not affected. In lobules which are affected, dark strips of dense cytoplasm may be present. This close connection between the presence of connective tissue elements and lipomatosis is still more marked in capsular lipomatosis in which the aggregation of fatty cells and their products develops in the fibrous capsules of the gland. In the parotid of the echidna, the capsule was thick and lipomatosis (Plate 2, Fig. 2) was fairly well demonstrated in it.

Paratrabecular and capsular lipomatosis do not differ much from interlobular lipomatosis. All three develop within the layers of connective tissue, and as the connective tissue spreads between the parenchyme, by means of interlobular connective layers, interlobular lipomatosis follows this path and penetrates the glandular structure (Plate 2, Fig. 3). Expanded lipomatosis of this type involves the glandular parenchyme, giving a picture of additional marginal destruction of the lobules. Frequently, in the vicinity of interlobular lipomatosis, dispersed alveolar lipomatosis of the parenchyme is present.

Another type of lipomatosis which spreads through connective tissue layers is peritubular lipomatosis which was especially well pronounced in the submaxillary gland of the guinea pig, though the parotid gland is usually affected. Accumulation of fatty materials around the excretory ducts results in the complete isolation of the ducts from the parenchymatous and connective tissue (Plate 2, Fig. 4), and even in the collapse of the whole duct, thus preventing salivary flow from that part of the lobule.

## V. DISCUSSION

The presence of lipomatosis in the connective tissue or in the parenchyme indicates two different processes, one being the formation of fatty cells within the connective tissue from the cells of the connective tissue and the second being the transformation of the glandular (epithelial) cells. So long as connective tissue lipomatosis does not invade the parenchyme the secretory processes are not affected. On the other hand, extension of the connective tissue lipomatosis to the parenchyme affects the peripheral parts of the lobules and, accordingly, may diminish the amount of the secretory outflow. However, the obstruction of the ducts in this type of lipomatosis does not occur.

Peritubular and areal lipomatosis, in contrast to peripheral lipomatosis, may block the outflow of secretion even if it is not very extensive in area, and by stopping the outflow of secretion, may affect, secondarily, a great number of the secretory cells.

Lipomatic aggregations within the cells appear in the basal part of the cells in the infranuclear region—the region in which secretory products first start to develop. The destruction of the basal part of the cell by fatty material is sufficient to paralyse the activity of the cell.

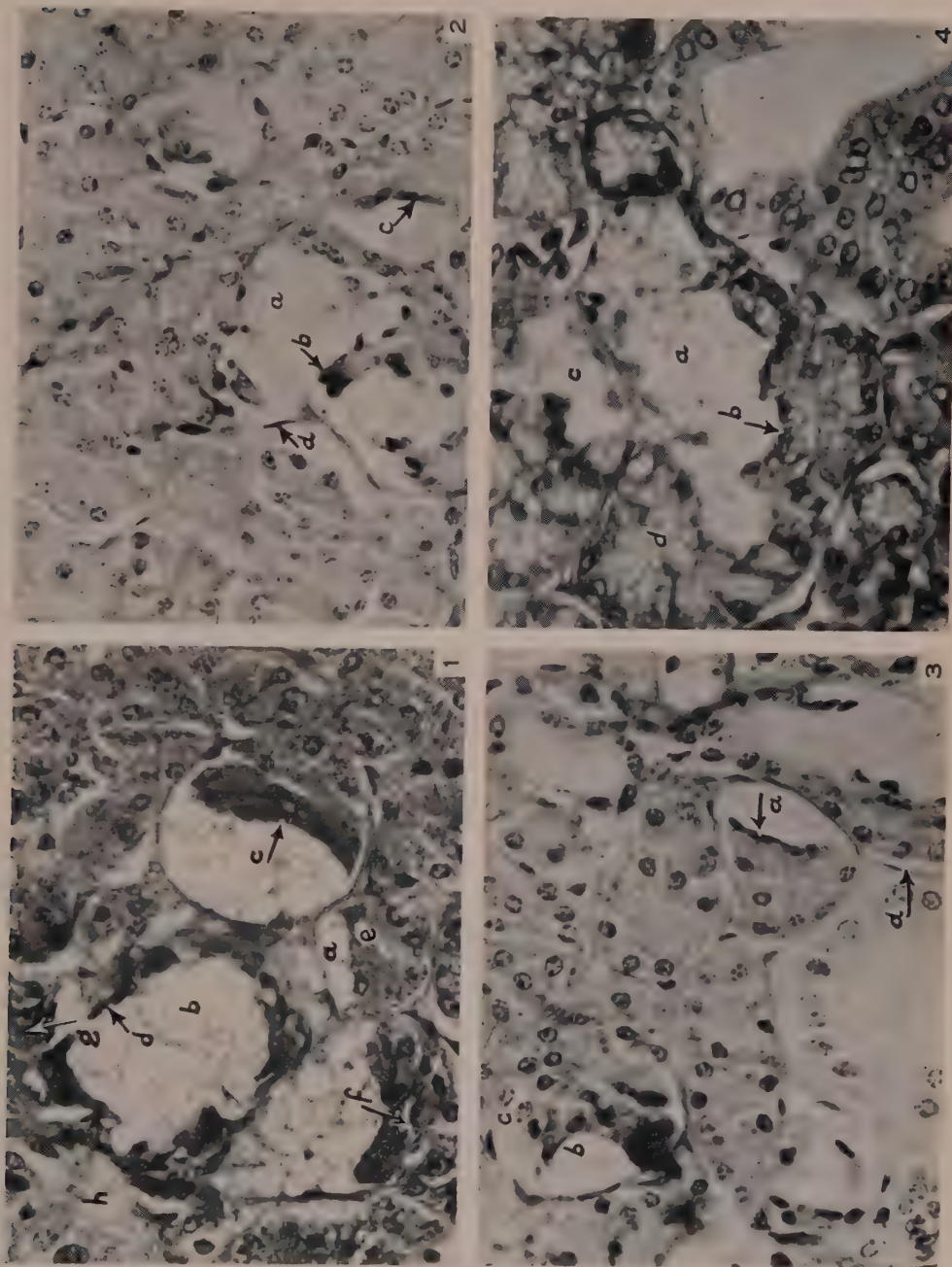
Cells which survive in the affected area have cytoplasm which is denser and which stains darkly; their nuclei become pycnotic. However, they last longer than the cytoplasm, and their remains can be observed even in completely destroyed alveoli. Pycnotic nuclei at the margin of the alveolar cytoplasm form a nuclear barrier, which is characteristic.

It seems apparent from the above survey, that changes caused in the salivary glands by an accumulation of fat are of two distinctly different types: one being a disintegration of secretory cells without visible reactions or transformations of the cell itself, the other giving a picture of various stages of cellular destruction.

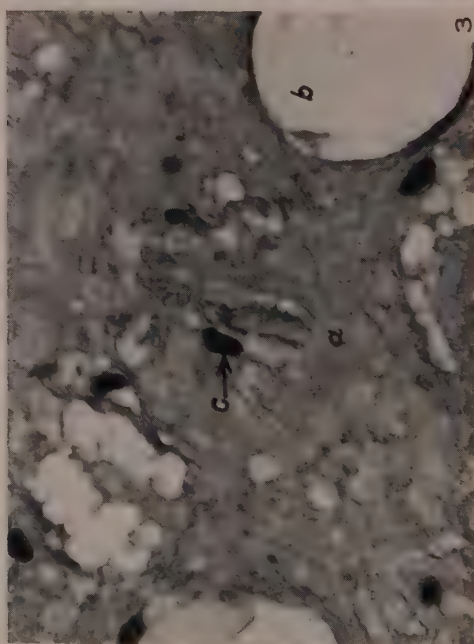
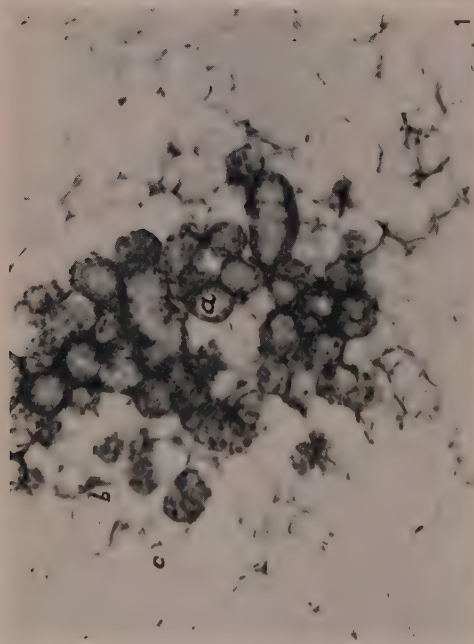
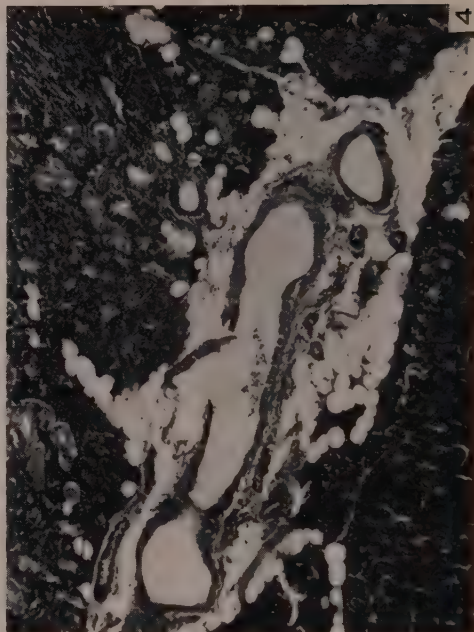
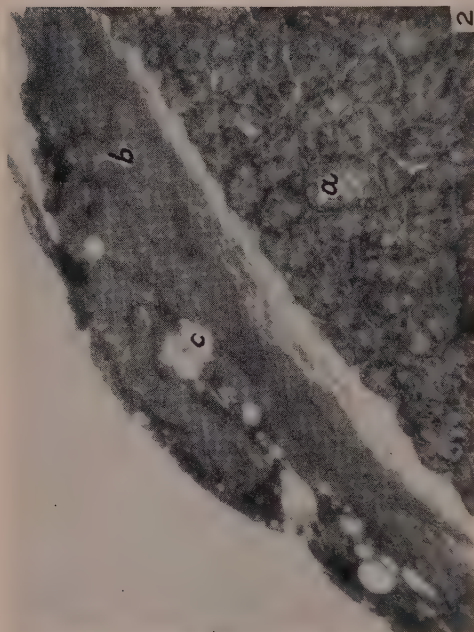
The most common parenchymal form of lipomatosis is the disseminate lipomatosis while among lipomatoses related to connective tissue, interlobular and



## LIPOMATOSIS IN MAMMALIAN SALIVARY GLANDS



LIPOMATOSIS IN MAMMALIAN SALIVARY GLANDS





capsular lipomatosis are the most frequent. Parenchymal lipomatosis was recorded mostly in the parotid while the connective tissue lipomatosis was recorded in the submaxillary gland.

## VI. ACKNOWLEDGMENTS

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## EXPLANATION OF PLATES 1 AND 2

### PLATE 1

- Fig. 1.—Central alveolar lipomatosis in the parotid gland of the echidna. Masson stain.  $\times 410$ . *a*, Lipomatic changes at the margin of the alveolus; *b*, accumulation of fatty granules within the alveolus; *c*, compressed, dense, and darkly stained cytoplasm; *d*, translocated and pycnotic nuclei; *e*, unaffected cytoplasm; *f*, changed and compressed lumina; *g*, indirectly affected alveolus; *h*, tubule of neighbouring alveolus.
- Fig. 2.—Destruction of the alveolus by marginal lipomatosis in the parotid gland of the echidna. Iron haematoxylin stain.  $\times 250$ . *a*, Accumulation of fat; *b*, nuclear remnants; *c*, barrier of pycnotic nuclei; *d*, translocated myoepithelial cell.
- Fig. 3.—Nuclear barriers and nuclear behaviour in marginal lipomatosis in the parotid gland of the echidna. Iron haematoxylin stain.  $\times 250$ . *a*, Nuclear barrier; *b*, translocation and pycnosis of nuclei; *c*, changes of nuclei due to the diminution of the amount of cytoplasm; *d*, myoepithelial cell.
- Fig. 4.—Nuclear barriers in areal lipomatosis in the parotid gland of the echidna. Haematoxylin and eosin stain.  $\times 250$ . *a*, Fatty accumulation; *b*, nuclear barrier; *c*, marginal lipomatosis; *d*, functional lumen in the affected alveoli.

### PLATE 2

- Fig. 1.—Island of mucous cells in the sublingual gland of the guinea pig. Haematoxylin and eosin stain.  $\times 410$ . *a*, Insular alveoli; *b*, remnants of alveoli; *c*, fatty accumulation.
- Fig. 2.—Capsular lipomatosis in the parotid gland of the echidna. Masson stain.  $\times 62.5$ . *a*, Glandular parenchyme; *b*, capsule; *c*, lipomatic aggregations.
- Fig. 3.—Interlobular lipomatosis in the submaxillary gland of the bandicoot. Gallego stain.  $\times 250$ . *a*, Interlobular connective tissue; *b*, interlobular lipomatosis; *c*, mast cells.
- Fig. 4.—Complete isolation of a secretory duct by peritubular lipomatosis in the submaxillary gland of the guinea pig. Gallego stain.  $\times 62.5$ .

GEOGRAPHIC VARIATION IN THE WEEBILL, *SMICRORNIS BREVI-ROSTRIS* (GOULD) (PASSERES: MUSCICAPIDAE, MALURINAE), A SEDENTARY SPECIES WITH A CONTINUOUS RANGE

By A. KEAST\*

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*Summary*

The present paper analyses geographic variation in *Smicrornis brevirostris* (Gould), a sedentary species of unusual colour plasticity, and which shows marked and irregular geographic variation.

Two main feather pigments are involved in this variation, a yellow one (phaeomelanin) and an olive-brown one (eumelanin). Changes in coloration correspond closely with changes in the climatic environment, and they follow definite lines. Yellow forms are found in a broad zone extending across the north of the continent, where the temperature is high and rainfall is restricted to the summer (giving a warm, dry climate). Brown forms occur across the southernmost third (cold and relatively wet climate). Pallid forms, in which neither pigment is well developed, are typical of arid areas (low rainfall, intermediate temperatures). Parts of the continent over which the average rainfall increases rapidly are associated with steep colour clines and these occur at various places around the periphery.

Variation in *S. brevirostris* is essentially an expression of Gloger's ecogeographic rule and, in that there is a south-north size cline, Bergmann's rule also. Its interest lies in the degree of colour variation displayed, the way in which this can be explained, and the difficulty associated with fitting the variation into the trinomial system of nomenclature.

I. INTRODUCTION

From time to time the taxonomist encounters a species that shows exceptional geographic colour variation and has a large number of readily distinguishable forms. Such a species presents various problems, particularly from the viewpoint of the basis of the variation and as to how the trinomial system of nomenclature can be applied to the various forms. Some are inevitably more distinctive than others, hence two taxonomists could, theoretically, recognize a different number of races or else arrange the geographic variates in a slightly different manner. In the present paper such a species, *Smicrornis brevirostris* (Gould), is analysed.

This species ranges, without isolation, over a considerable part of the Australian continent. It is versatile in the type of habitat occupied and, whilst primarily an inhabitant of savannah and dry sclerophyll forest, ranges far out into the desert. Eucalypts are apparently an essential part of its desert habitat (Berney 1905; Whitlock 1921; McGilp 1922) though, contrary to what was suggested by Keartland (see North 1903), apparently not surface water.

*S. brevirostris* feeds exclusively amongst the outer foliage of trees and, though the foreshortened bill suggests a specialized food (e.g. scale insects), stomach analyses show it to be a most generalized insect feeder. Included in its diet are

\* Australian Museum, Sydney.



various Hemiptera (aphids, leaf-hoppers, jassids, fulgorids, scales, psillids), the smaller Coleoptera (weevils, leaf-beetles), Hymenoptera (ants, chalcids, chrysids), Diptera, and spiders (Cleland *et al.* 1918; Roberts and Jarvis 1923; Lea and Grey 1935). It is possibly this versatility in diet that underlies the success of *S. brevirostris* in occupying a range of forest types and thriving in arid places.

TABLE 1  
SIZE VARIATION IN ADULT MALES OF SMICRORNIS BREVIROSTRIS

The wing has been measured from its angle to the tip, straightened along a rule, the tail from between the base of the central-most feathers to the tip. Mean values are shown in parenthesis

Race	Locality	Sample Size	Wing Length (mm)	Tail Length (mm)
<i>S. b. brevirostris</i>	Bunya Mountains, Qld.	5	49-53 (52)	32-35 (33)
	Sydney	8	49-54 (53)	33-37 (35)
	Darling R., western N.S.W.	9	50-53 (51)	32-34 (33)
	Melbourne	8	50-55 (53)	31-36 (33)
	Adelaide, Eyre Peninsula, S.A.	8	49-54 (51)	32-37 (34)
<i>S. b. mallee</i>	Victorian Mallee	6	50-54 (52)	32-36 (34)
<i>S. b. stirlingi</i>	King George Sound, Stirling Ranges, Broome Hill, W.A.	8	50-55 (52)	32-35 (34)
<i>S. b. mathewsi</i>	Macdonnell Ranges, N.T.	8	49-53 (51)	30-34 (32)
	Hammersley area, W.A.	5	50-53 (52)	30-34 (32)
<i>S. b. pallescens</i>	Rockhampton, Qld.	3	50-52 (51)	32-35 (34)
	Mt. Abbott, near Bowen, Qld.	2	50, 51	32, 34
	Cooper's Creek, Qld.	2	50, 51	32, 34
<i>S. b. flavescens</i>	Derby, W.A.	4	48-51 (49)	29-33 (31)
	Napier Broome Bay and Parry's Creek, W.A.	8	47-49 (48)	29-31 (30)
	Port Keats and Eureka, N.T.	3	45-47 (46)	29-31 (30)
	Normanton, Qld.	5	45-49 (47)	29-32 (30)
	Melville I., N.T.	5	43-47 (46)	29-31 (30)
	Coen area, Cape York, Qld. (Thomson's measurements)	2	45, 46	—
<i>S. b. cairnsi</i>	Cairns, Qld.	6	49-51 (50)	30-35 (33)

## II. MATERIALS AND METHODS

The taxonomic section of this work was carried out on the bird collections of the American Museum of Natural History, New York (which includes the Mathews types), and the Australian Museum, Sydney.

Standard taxonomic methods have been followed in the study of geographic variation. Methods of measurement of appendages are described in Table 1. These

are given for males only and are limited to wing and tail lengths. Bills were not measured as, owing to their small size, this could not be done with the accuracy necessary in the study of geographic variation.

### III. GEOGRAPHIC VARIATION

#### (a) Size

Measurements for several series of adult males of *S. brevirostris* from various parts of their range are set out in Table 1. Three deductions may be made from the measurements: (1) size variation is relatively minor; (2) each series of measurements overlaps the preceding one, indicating a continuous cline; and (3) the populations in the north of the continent are smaller than those in the south.

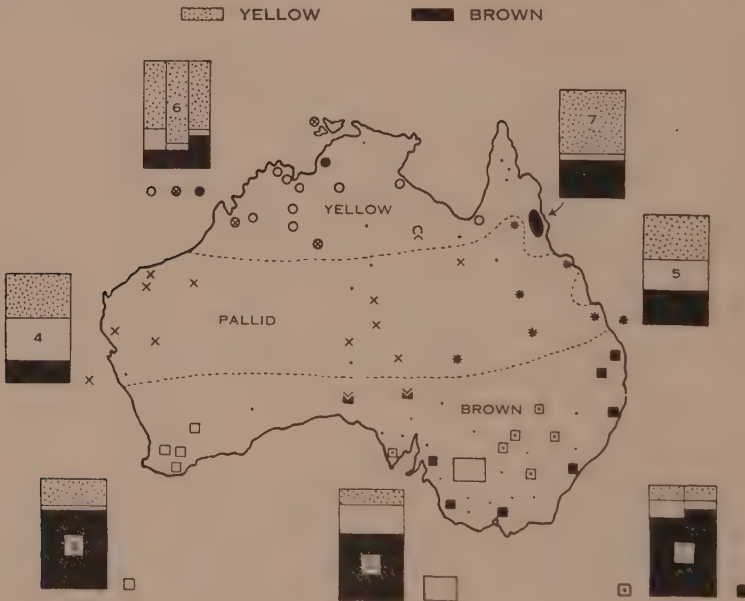


Fig. 1.—Distribution of the various colour forms in *Smicrornis brevirostris*. Diagrams 1-7 indicate the suggested proportions of brown pigment (solid areas) and yellow pigment (dotted areas) in the make-up of the various forms. The values are not absolute but meant as a relative guide only. The symbols within the map show the distribution of the major colour forms.

#### (b) Colour

Intrapopulation variability in *S. brevirostris* is limited. The sexes are similar in colour, as in size, and the immature bird is, if anything, only slightly more drab than the adult.

Geographic variation is considerable. Three general colour types occur, essentially yellow, pallid, and brown, which occupy broad belts across the north, centre, and south of the continent respectively (Fig. 1). There is also much "irregular" variation from one part of the range to another, in some cases there being little change over wide areas and in others adjacent series being distinguishable.



(i) *Predominantly Brown Forms*

(1) *S. brevirostris brevirostris* (Gould), 1838. Southern Queensland to South Australia, coastal and near inland (Fig. 1, 1, ■). This is the nominate form and in the typical bird the back is grey-brown suffused with olive and the breast is greyish white with the faintest yellowish wash. Series of birds from different parts of the range vary slightly. Compared with the northern Bunya Mountains-Burnett R. forms those from Sydney (coastal) are slightly more olive ventrally. Darling R., N.S.W. (inland) specimens (Fig. 1, 1, □) are less olive on the back and paler ventrally. Melbourne and Adelaide birds (peripheral) agree with those from Sydney.

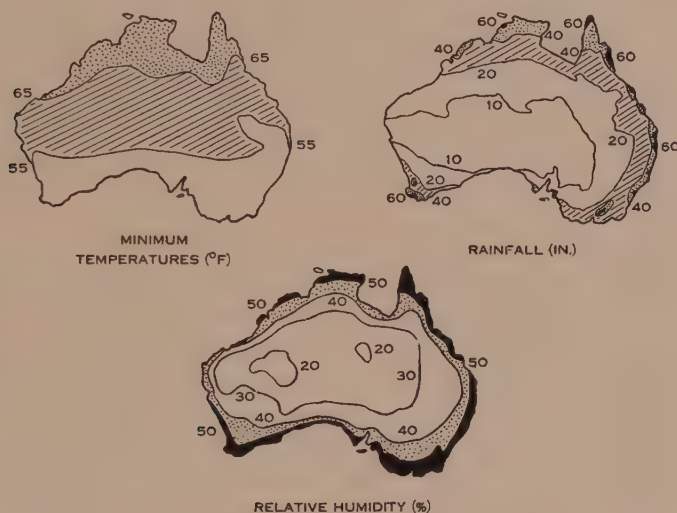


Fig. 2.—Maps showing minimum temperature isotherms, isohyets, and relative humidities (at 3 p.m. daily, annual means) for comparison with the distribution of the various colour forms of *Smicrornis brevirostris*.

Northwards from Melbourne this form merges into the pale one from the Victorian Mallee (*b. mallee*). A colour cline connects the form in coastal South Australia with the pallid form of the centre of the continent (*b. mathewsi*). Birds from Leigh Creek, northern South Australia, are intermediate between the two.

(2) *S. b. mallee* Mathews, 1920. Victorian Mallee (see Fig. 1, 2, □). This population is distinctly paler (i.e. whiter) ventrally and on the side of the head and there is noticeably less olive dorsally than in *b. brevirostris*.

(3) *S. b. stirlingi* Mathews, 1912. South-western corner of Australia (Fig. 1, 3, □). These birds resemble the eastern "brown" type but have a strong development of olive throughout, giving them an olive-yellow breast and a dark brownish olive back. Typical birds have been seen from as far inland as Southern Cross. Birds from the Nullarbor Plain are somewhat paler and are intermediate between *b. stirlingi* and *b. mathewsi*.

(ii) *Pallid Forms*

(1) *S. b. mathewsi* White, 1915. Mid-western Australia (coastal) to central Australia (Fig. 1, 4, ×). In this form the top of the head is grey-brown and the back is mid-brown with an olive tinge through it. The throat and breast are white, the abdomen pale yellow. Many of the series are limited to two or three birds but there is evidence of minor geographic variation in Western Australia. For example, birds from Nullagine are slightly paler than those from Roebourne and the Fortescue R. Specimens from central Australia (Musgrave Ranges, Hugh R., Finke R., Oodnadatta, Macdonnell Ranges) and Mt. Isa are similar and agree well with the birds from Carnarvon, W.A.

(2) *S. b. pallescens* Mathews, 1912. Interior and drier areas of Queensland (Fig. 1, 5, \*). These birds differ only slightly from *b. mathewsi*. The crown is tinged with olive, instead of being grey-brown, and there is slightly more yellow on the side of the face and ventrally. Birds from as far apart as Cooper's Creek and Minnie Downs in the arid interior and from the drier parts of the coast such as Gracemere, Rockhampton, Walsh R., and Inkerman, Qld., whilst differing slightly from each other, fall into this general type.

(iii) *Yellow Forms*

(1) *S. b. flavescens* Gould, 1843. Kimberleys to Gulf of Carpentaria (Fig. 1, 6, ○, ⊗, ●). These are very yellow birds. The breast is a rich yellow, the throat whitish, the side of face light gingerish brown, top of head light brown, the back pale brown strongly suffused with olive-yellow, and the rump olive-yellow.

Within the range of this form there is a certain amount of variation. Good series from Derby and Melville I. plus a pair of birds obtained by the author at Tanami are the "most yellow" (see Fig. 1, 6, ⊗). There is negligible difference between small series (twos and threes) from much of the range, viz. Napier Broome Bay, Mungi, Parry's Creek, Hall's Creek, Wilson R., Forrest R. (near Wyndham), Eureka, Crawford Springs. Normanton birds (Gulf of Carpentaria) and those from Alexandria Downs (inland N.T.) are slightly paler. A pair of birds from Port Keats (Fig. 1, ●) are darker than the typical, having a greyish tinge through the throat, side of head, and top of the head. Further specimens may indicate that this population warrants a name.

Campbell (1919) states that birds from King R., N.T., McArthur R., Gulf of Carpentaria, and the Kirrama Tableland, near Cardwell (east coast) are similar in coloration to those from Napier Broome Bay (Kimberleys). Thomson (1935) describes birds from Ebagoola and Coen, Cape York, as "very light" in colour.

(2) *S. b. cairnsi*, subsp. nov. Cairns and adjacent areas of high rainfall (Fig. 1, 7, black ellipse). This form is paler ventrally than *b. flavescens* but has the top of the head and upper back much darker (greyer). It grades into the pallid *b. pallescens* immediately to the west (Walsh R.) and south (Inkerman).

(c) *Reasons for Colour Variation*

(i) *Genetical*.—There does not appear to be any doubt that the geographic variation in *S. brevirostris* has a genetic basis, for the following reasons:



- (1) In the case of the large geographic samples the individuals were not collected contemporaneously but in different years and at different times of the year. They are fairly uniform, however.
- (2) The author collected specimens of *S. brevirostris* in the winter of 1952 from the following localities: Macdonnell Ranges, Tanami, Hall's Creek, Wilson R., Forrest R., Port Keats, and Mt. Isa. Notwithstanding that a record drought was in progress over much of the terrain, and that conditions varied considerably from place to place, the pattern of colour variation agreed with that previously recorded.
- (3) Mathews (1924) long ago stressed the constancy of colour differences between the populations of *S. brevirostris*.
- (4) Mayr (1942) has discussed phenotypy in birds and points out that no case is on record of birds having changed their colour, owing to unusually strong seasonal influences, in being introduced to new continents or, with one or two special exceptions, following captivity. Phenotypic variation in birds is known to be exceedingly narrow.

(ii) *Isolation*.—Isolation would appear to play, or have played, only a limited role in the development and maintenance of the various colour types. The species is obviously continuous in its distribution throughout the eastern segment, an area involving brown, pallid, and yellow forms (and colour types 1, 2, 5, and 7, Fig. 1). It is difficult to conceive of past isolation through this segment.

There is a thinning and break-up in the range of *S. brevirostris* in the interior. The author found it absent from treeless sections between Port Augusta (brown form) and the Macdonnell Ranges (pallid form), and between the latter and Tanami (yellow form), also over sections of the Barkly Tableland. Presumably the Arunta and Great Sandy Deserts are unoccupied, though the forms to the east and west of them are fairly similar. Possibly the 90 Mile Beach arid strip separates pallid from yellow forms in the north-west.

*S. brevirostris* has the ability to live in eucalypt and mallee pockets in arid areas (Leigh Creek, Ooldea, Tanami). This, and its occurrence in the continuous savannah around spinifex and gibber desert, indicates that no form is completely isolated. This is supported by the observed intergrading of many of the forms. Hence the basis of geographic colour variation in this species must be sought elsewhere.

(iii) *Feather Pigmentation and Climate*.—Colour variations in *S. brevirostris* obviously results from the interplay of two major pigments, a brown one and a yellow one, the dominant giving the form its colour. Where both are limited the birds are pale. That the former is a eumelanin and the latter a phaeomelanin is shown by the work of Frank (1938, 1939).<sup>\*</sup> The occurrence of these pigments is known to be correlated with environment. Thus, Mayr (1942) states: "Reddish or

<sup>\*</sup> Frank (1938) gives an excellent analysis of the relationship between phaeomelanin pigmentation and climate in the case of the Palaearctic titmouse *Parus atricapillus*. His distribution map is reproduced by Mayr (1942). Frank (1939) subsequently produced an extensive review paper on the subject of feather colouring in birds.

yellowish brown phaeomelanins prevail in arid climates where the blackish eumelanins are reduced. The phaeomelanins are subject to reduction in cold climate . . . . .”

Relationship between the coloration of *S. brevirostris* and the environment can best be discussed by expressing the former in quantitative fashion. There is no exact method of doing this as procedures for the analysis of these pigments have not yet been developed. A relative appreciation can be gained, however, by arbitrarily allocating to each form percentage values for “degree of brownness” and “degree of yellowness”. Thus, the southern populations would be credited with 60–80 per cent. of the brown pigment and 10–20 per cent. of the yellow one. In the northern populations these percentages are reversed. Pale forms from the intermediate zones are distinguished by low values for both pigments. The characters of the various populations, expressed in this arbitrary fashion, are set out in Figure 1.

The distribution of temperature, rainfall, and humidity belts over the Australian continent are given in Figure 2 (data extracted from Climatological Atlas for Australia, Commonwealth Meteorologist, Melbourne). Temperature zones extend in broad belts across the continent from north to south. Rainfall distribution takes the form of concentric belts of increased rainfall outwards from an interior arid region. Relative humidity and saturation deficit of water vapour pressure (map in Prescott 1934) have, to a degree, a similar distribution pattern to rainfall.

A general agreement between the distribution of the three major colour types and temperature will be noted from a comparison of Figures 1 and 2. Brown birds occur to the south of the 55°F line and yellow birds to the north of the 65°F line of annual minimum temperatures (which give a slightly better correlation than either mean or maximum figures).

A correspondence between the rainfall and distribution of the pigmented and pale forms will be noted, the latter occurring through the dry interior and on the west coast where the climate is dry. Over the north of the continent, where yellow birds occur, the rainfall occurs in the hot, dry summer, so that the climate there is actually also a relatively dry one. This is in contrast to the south-west (brown forms), where winter is the wet season, and the south-east (brown forms), where there is both winter and summer rain.

Several facets of the variation in *S. brevirostris* would now appear to be explained. The cline of increasing paleness from the coast inland corresponds to the falling off in mean rainfall. In the south, for example, three stages in the production of a pale bird from a richly pigmented brown one are represented by series from Sydney, inland New South Wales, and the Victorian Mallee, over which section the rainfall drops from 40 in. to under 15 in. per annum. The rainfall map (Fig. 2) suggests how it is that forms from opposite sides of the continent can approach each other in coloration (e.g. the Cairns and Port Keats populations), the distribution of which corresponds to pockets of high rainfall surrounded by dry country. Corresponding with a rapid falling-off in rainfall inland from these pockets is a steep transition from pigmented to pallid form. It is likely also that the slight difference between forms from the western and eastern central sections of the



Continent and south-western and south-eastern corners are associated with the minor climatic differences between these regions.

## V. ECOLOGICAL SIGNIFICANCE OF VARIATION

### (a) *Application of Bergmann's Rule*

A considerable number of sedentary, widely ranging Australian birds have been found to follow Bergmann's ecogeographic rule, being smaller in the northern (warmer) parts of the range. Members of families as diverse as the Falconidae (Condon and Amadon 1954), Muscicapidae (Mayr 1954), and Meliphagidae (Keast, unpublished data) conform to this rule.

The  $12\frac{1}{2}$  per cent. size increase in *S. brevirostris* (as judged from mean wing lengths (see Amadon 1943)) over 1500 miles (averaging 8 per cent. per 1000 miles) from the north to the south of the continent, accords well with that in certain other species, e.g. *Rhipidura leucophrys* (Keast 1958). The corresponding decrease in the average daily minimum temperature for the year is almost 45 per cent. (from 65–70°F at Cape York to 45°F at Melbourne).

### (b) *Application of Gloger's Rule*

Gloger's rule also has the widest application in Australian birds and almost all sedentary species of wide range conform to it to a greater or lesser extent.

*S. brevirostris* is exceptional in two ways, in its unusual plasticity so that colour changes are associated with relatively minor climatic changes, and in that the major colour forms occur in broad belts from north to south across the continent. The author has come across only two other bird species in which colour forms are arranged in this way. These are *Meliphaga penicillata* and *Melithreptus gularis* (both Meliphagidae), and fulfil the requirements of having the same types of feather pigment, are of equally wide distribution, and are fairly sedentary.

In neither *M. penicillata* nor *M. gularis* does the range of the brown, pallid, and yellow forms correspond with those of *S. brevirostris*. In the former, brown birds occur in the south-east, pallid ones across the interior, and yellow ones along the mid-western and north-western coast. In *M. gularis* there is a "dark brown" Tasmanian form, a "brown" form in the south-east of the continent, and a "yellow" form extending through the interior and north. The existence of south-north "colour belts" in three species suggests that certain temperature-rainfall thresholds operate in a way to initiate changes in the dominant feather pigment. Thus a somewhat specialized expression of the Gloger effect would appear to be involved.

The remarks of Mayr (1956) should be noted with respect to the ecogeographical rules of Bergmann and Gloger: . . . . . "it is becoming increasingly evident that such ecotypic adaptations manifesting themselves in the ecological rules are the means of reaching a balance between the need for local adaptedness and the physiological heritage of the species as a whole."

## VI. NOMENCLATURE AND NEW SYNONYMY

Subspecies, as used in the modern sense, may be defined as: ". . . geographically defined aggregates of local populations which differ taxonomically from other such divisions of a species" (Mayr, Linsley, and Usinger 1953). "Taxonomically

different" is stated to be a degree of difference "sufficiently great that it is possible to identify the great majority of specimens without knowledge of their provenience". A commonly accepted test is that over 75 per cent. of the specimens must be identifiable from all other individuals of other subspecies of the species.

It is apparent that many of the colour forms in *S. brevirostris* can justifiably be called subspecies for they are distinguishable from other forms, and within a series from any one area there is a high degree of homogeneity. Equally, however, each is apparently no more than a genetically based response to the climatic variables in the environment. There are, accordingly, two alternatives: not to recognize any subspecies and, instead, insert a statement describing the nature of the variation; or to make a somewhat arbitrary decision as to the number to be recognized.

The author takes the view that it is desirable, for the sake of consistency in the scheme of classification, to adopt the latter course, provided that the true nature of the variation be recognized.

Seven aggregates of populations in *S. brevirostris* fall into the category of being distinctive. With one exception they have already been given names. These, together with the named forms of lesser degree that can best be grouped within them, are as follows:

1. *Smicrornis brevirostris brevirostris* (Gould), 1838. Synonym: *viridescens*.
2. *Smicrornis brevirostris mallee* Mathews, 1920.
3. *Smicrornis brevirostris stirlingi* Mathews, 1912. Synonym: *bonapartei*. The name *occidentalis*, given to south-western birds by Bonaparte in 1851 is a nomen nudum. Hence this form takes the next oldest name, *stirlingi*.
4. *Smicrornis brevirostris mathewsi* White, 1915.
5. *Smicrornis brevirostris pallescens* Mathews, 1912.
6. *Smicrornis brevirostris flavescens* Gould, 1843. Synonyms: *mungi*, *rogersi*, *melvillensis*, *subflavescens*.
7. *Smicrornis brevirostris cairnsi*, subsp. nov. The type, an adult female, is in the Australian Museum Collection (O. 38631) and was collected at Wandeeela, Qld., on January 10, 1946, by A. F. Austin and A. M. Barnett. The American Museum of Natural History has a good series of birds from the Cairns area.

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# A REVIEW OF THE AUSTRALIAN RUTELINAE (COLEOPTERA : SCARABAEIDAE)

By P. B. CARNE\*

[Manuscript received February 19, 1958]

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## Summary

The subfamily Rutelinae is represented in Australia (including Tasmania) by 21 genera comprising 96 species and 6 subspecies. Of these, two species belong to the tribe Anomalini, one to the Adoretini, and the remainder to the indigenous tribe Anoplognathini.

The subfamily is well represented in Queensland and in New South Wales, poorly so in Tasmania and in Western Australia. Of the two subtribes of the Anoplognathini, the Schizognathina is the more highly specialized. Some genera include forms that have sexually dimorphic modifications of the mouthparts and sensory organs that are very similar to those of some Dynastinae.

The following alterations and additions are made to the taxonomy of the group:

New genera.—*Exochogenys*, *Dungoorus*.

New species.—*Paraschizognathus brunneus*, *elgatus*, *elgatus* subsp. *kiewarrus*, *ocularis*, *pinarus*, *queenslandicus*, *tubrabuccae*; *Schizognathus rugulosus*; *Amblyterus deuqueti*, *simplicitarsus bundabergensis*, *tibialis*; *Mesystoechus costatus*; *Dungoorus murrumbullus*.

Species names placed in synonymy.—*Repsimus purpureipes* Macleay (under *R. aeneus* (F.)); *Calloodes nitidissimus* Lea (*frenchi* Ohaus); *Anoplognathus antiquus* Arrow (*Trioplognathus griseopilosus* Ohaus); *Pseudoschizognathus occidentalis* Ohaus (*schoenfeldti* Ohaus).

New combination.—*Exochogenys nigripennis* (Blanchard).

Changes of status.—*Repsimus manicatus* (Swartz) var. *montanus* Lea given subspecific status. Genus *Mesystoechus* Waterhouse transferred from tribe Rutelini to tribe Anoplognathini.

\*Division of Entomology, C.S.I.R.O., Canberra.



## I. INTRODUCTION

The most recent systematic study of the Rutelinae of the Australian region is that of Ohaus who published a revision of the group in 1904, supplementary notes in subsequent years, and finally a catalogue of the world fauna in 1918. Since that time additional species have been described by Arrow, Lea, and the present author.

This review includes keys to the tribes, subtribes, genera, and species of the subfamily as it is known in Australia. Thirteen new species and two new genera are described, and four new synonymies recorded. The limits of genera are redefined in the light of the species now referred to them. Supplementary notes are given for all previously described species, other than those of *Clilopocha* Lea, *Saulostomus* Waterhouse, *Eosaulostomus* Carne, and *Anoplognathus* Leach, these genera having been revised by the author in recent years (Carne 1954, 1955, 1956, 1957a).

Altogether 21 genera comprising 96 species and 6 subspecies are recognized. Of these, 19 genera and 93 species belong to the indigenous tribe Anoplognathini. The only exotic element in the fauna consists of two species of *Anomala* (Anomalini) and one of *Adoretus* (Adoretini).

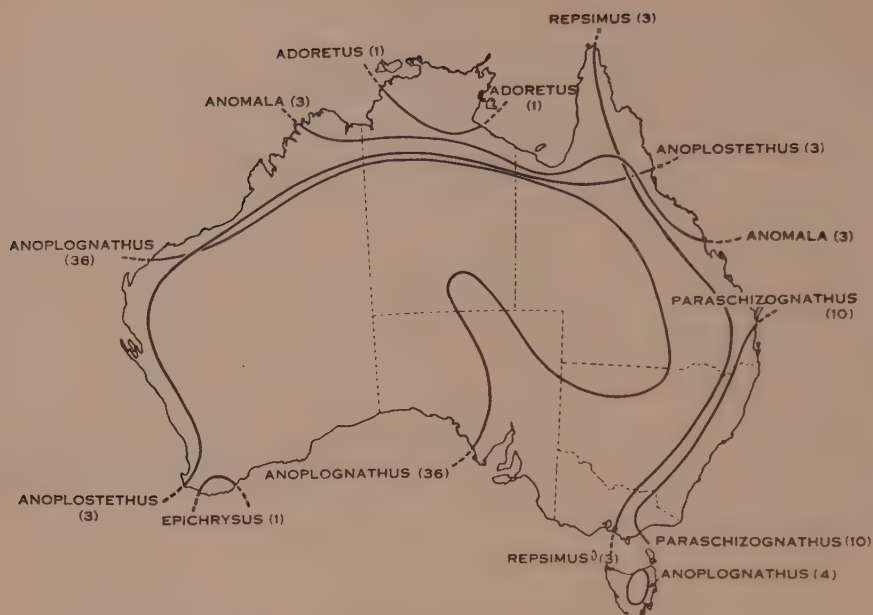
TABLE 1  
NUMBER OF RUTELINE SPECIES FOUND IN EACH STATE

Tribe	Qld.	N.S.W.	Vic.	Tas.	S.A.	W.A.	N.T.
Anomalini	2	—	—	—	—	—	—
Anoplognathini							
Anoplognathina	41	32	14	4	3	5	2
Schizognathina	24	14	4	1	8	2	—
Adoretini	—	—	—	—	—	—	1

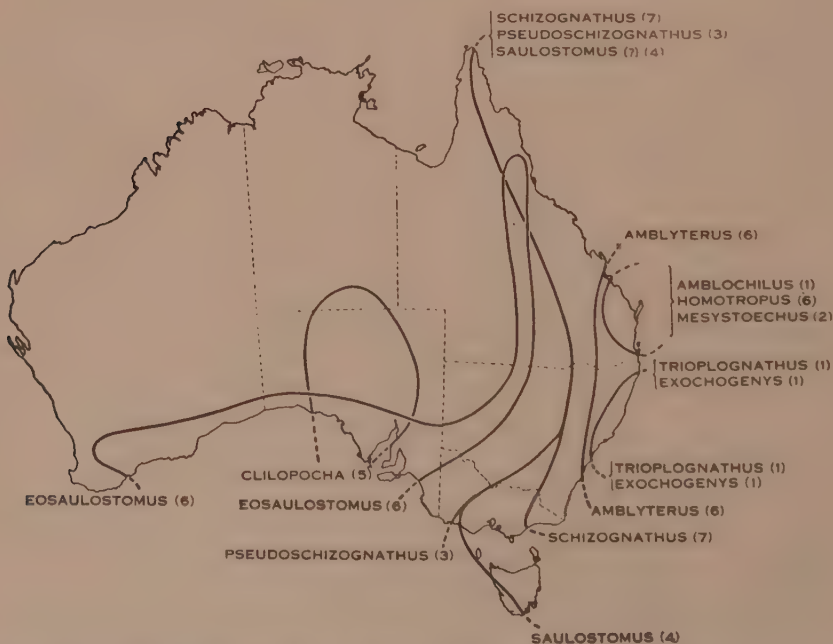
## II. DISTRIBUTION OF THE FAUNA

The distributions of individual species are given in broad terms in the subsequent list (p. 166); more detailed information is recorded under species descriptions. A summary of the distributions of different genera is presented in Maps 1 and 2. In these maps, the inland limit of each genus is indicated approximately. It will be noted that the subfamily is best represented in Queensland and in New South Wales, poorly so in Tasmania and in the north and west of the continent. An analysis of the number of species found in each State is given in Table 1. A summary of the number of species and subspecies in each tribe is given in Table 2.

The majority of species occur on or near the coasts, very few in the arid interior. There appears to be continuity between the Western Australian and Queensland faunas, some species following the coastal belt across the north. Thus all three species of *Anoplostethus* occur in both States, while one species of the Queensland genus *Calloodes* is found in north-western Australia. One species only (*Calloodes atkinsoni* Waterh.) of the native fauna is known to have extended its range beyond the mainland (to New Guinea).



Map 1.—Approximate inland limits of genera of the tribes Anomalini, Adoretini, and Anoplognathini, subtribe Anoplognathina. The number of species referred to each genus is shown in parenthesis.



Map 2.—Approximate inland limits of genera of the tribe Anoplognathini, subtribe Schizognathina. The genus *Homotropus* is also represented in a small area of south-eastern Victoria (not shown). The number of species referred to each genus is shown in parenthesis.

Of the two tribes of the Anoplognathini, the Schizognathina includes the more specialized forms. The Anoplognathina are robust insects with well-developed mouthparts and without marked sexual dimorphism of the sensory organs; some exceptions are found in the *olivaceus* species group of *Paraschizognathus*. The Schizognathina includes many species in which the sensory organs are greatly modified in the male, and in which the mouthparts are considerably reduced. Such insects characteristically inhabit harsher environments than do the less specialized forms; in morphology they recall the subtribe Pseudoryctina of the Dynastinae (Carne 1957b).

TABLE 2  
NUMBER OF SPECIES AND SUBSPECIES IN EACH TRIBE

Tribe	Species	Subspecies
Anomalini	2	—
Anoplognathini		
Anoplognathina	50	6
Schizognathina	43	—
Adoretini	1	—
Totals	96	6

In this paper, detailed locality and collection data are given only for new or rare species. The collections from which specimens were examined are listed under the following abbreviations:

AM	Australian Museum, Sydney.
BM	British Museum (Natural History), London.
BSES	Bureau of Sugar Experiment Stations, Brisbane.
CFD	Private collection of Mr. C. F. Deuquet, Hurstville, Sydney.
CSIRO	Division of Entomology Museum, C.S.I.R.O., Canberra.
FEW	Private collection of Mr. F. E. Wilson, Malvern, Vic.
GFM	George Frey Museum, Tutzing, Germany.
JC	Private collection of Mr. J. A. Courtenay, Morwell, Vic.
JS	Private collection of Mr. J. Sedlacek, Cooma, N.S.W.
MACL	Macleay Museum, Sydney.
MDN	Museum nationale d'histoire naturelle, Paris.
NM	National Museum, Melbourne.
NRS	Naturhistoriska Riksmuseet, Stockholm.
QDAS	Queensland Department of Agriculture and Stock, Brisbane.
QM	Queensland Museum, Brisbane.
QU	Queensland University, Department of Entomology, Brisbane.
SAM	South Australian Museum, Adelaide.
WADA	Western Australian Department of Agriculture, Perth.
WAM	Western Australian Museum, Perth.
ZM	Zoologisches Museum, Humboldt Universitat, Berlin.

In generic and specific synonymies, only the more important references are given. For complete lists of references the reader is referred to Ohaus (1918).



## III. LIST OF THE AUSTRALIAN RUTELINAE\*

## RUTELINAE HOMALOCHILIDAE Ohaus

## Tribe ANOMALINI Péringuey

1. *Anomala* Samouelle

- |                                 |   |
|---------------------------------|---|
| 1. <i>antiqua</i> (Gyllenhal)   | N.Qld., N.T., N.W.Aust.<br>(and north to China) |
| 2. <i>aeneotincta</i> Fairmaire | N.Qld., N.W.Aust. (New<br>Britain, New Guinea)  |

## RUTELINAE ORTHOCHILIDAE Ohaus

## Tribe ANOPLOGNATHINI Ohaus

## Subtribe ANOPLOGNATHINA Ohaus

1. *Calloodes* White

- |                                |                       |
|--------------------------------|-----------------------|
| 1. <i>atkinsoni</i> Waterhouse | N.Qld.                |
| 2. <i>frenchi</i> Ohaus        | N.Qld.                |
| 3. <i>rayneri</i> Macleay      | Qld.                  |
| 4. <i>grayanus</i> White       | Qld., N.T., N.W.Aust. |

2. *Repsimus* Macleay

- |   |                          |
|---|--------------------------|
| 1. <i>aeneus</i> (Fabricius)                  | Qld., N.S.W.             |
| 2a. <i>manicatus manicatus</i> (Swartz)       | S.Qld., N.S.W., Vic.     |
| 2b. <i>manicatus montanus</i> Lea, stat. nov. | N.S.W., Vic. (highlands) |

3. *Anoplognathus* Leach*montanus* species group

- |                                  |                            |
|----------------------------------|----------------------------|
| 1. <i>viridiaeneus</i> (Donovan) | S.Qld., N.S.W. (coastal)   |
| 2. <i>rhinastus</i> Blanchard    | S.Qld., N.S.W.             |
| 3. <i>viriditarsis</i> Leach     | S.Qld., N.S.W., Vic., Tas. |
| 4. <i>montanus</i> Macleay       | S.Qld., N.S.W., Vic. S.A.  |

*macleayi* species group

- |  |                            |
|--|----------------------------|
| 5. <i>olivieri</i> (Dalman)            | S.Qld., N.S.W., Vic., Tas. |
| 6a. <i>macleayi macleayi</i> Blackburn | S.A., Cent. Aust.          |
| 6b. <i>macleayi aurora</i> Arrow       | N.W.Aust.                  |

*nebulosus* species group

- |  |                         |
|--|-------------------------|
| 7. <i>narmarus</i> Carne                 | N.S.W., S.A. (interior) |
| 8a. <i>nebulosus nebulosus</i> Macleay   | N.Qld.                  |
| 8b. <i>nebulosus acuminatus</i> Ohaus, ♂ | N.Qld.                  |
| 8c. <i>nebulosus moanus</i> Carne        | N.Qld. (Torres Strait)  |
| 9. <i>brevicollis</i> Blackburn, ♀       | N.T.                    |

*porosus* species group

- |                                    |                      |
|------------------------------------|----------------------|
| 10. <i>rugosus</i> Kirby           | N.S.W., Vic. Tas.    |
| 11. <i>porosus</i> (Dalman)        | Qld., N.S.W., Vic.   |
| 12. <i>pindarus</i> Carne          | N.S.W.               |
| 13. <i>chloropyrus</i> (Drapiez)   | S.Qld., N.S.W., Vic. |
| 14. <i>boisduvali</i> Boisduval    | Qld., N.S.W.         |
| 15. <i>prasinus</i> (Laporte)      | S.Qld., N.S.W.       |
| 16. <i>multiseriatus</i> Lea       | Qld., N.S.W.         |
| 17. <i>pallidicollis</i> Blanchard | Qld., N.S.W., Vic.   |

\*Both sexes are known except where otherwise indicated.

- concolor* species group
18. *concolor* Burmeister Qld., N.S.W.
  19. *abnormis* Macleay N.Qld.
  20. *rothschildi* Ohaus N.Qld., S.W.Aust.(?)
- punctulatus* species group
21. *aureus* Waterhouse N.Qld.
  - 22a. *punctulatus punctulatus* Olliff N.Qld.
  - 22b. *punctulatus insularis* Ohaus New Guinea
  23. *smaragdinus* Ohaus Qld.
  24. *aeneus* Waterhouse N.Qld.
- velutinus* species group
25. *velutinus* Boisduval S.Qld., N.S.W., Vic.
- suturalis* species group
26. *suturalis* Boisduval S.Qld., N.S.W., Vic., Tas.
  27. *hirsutus* Burmeister S.Qld., N.S.W., Vic.
  28. *rubiginosus* Macleay N.S.W.
- brunnipennis* species group
29. *parvulus* Waterhouse Qld.
  30. *brunnipennis* (Gyllenhal) Qld., N.S.W.
  31. *daemeli* Ohaus N.Qld.
4. *Epichrysus* White
1. *lamprimoides* White S.W.Aust.
5. *Anoplostethus* Brullé
1. *opalinus* Brullé W.A., N.Qld.
  2. *roseus* Blanchard N.T., N.Qld.
  3. *laetus* Rothschild & Jordan W.A., N.Qld.
6. *Paraschizognathus* Ohaus
- prasinus* species group
1. *prasinus* (Boisduval) N.S.W., Vic., Qld.(?)
  2. *pinarus*, sp. nov. N.S.W.
  3. *tubrabuccae*, sp. nov. N.S.W.
  - 4a. *elgatus elgatus*, sp. nov. N.S.W. (alps)
  - 4b. *elgatus kiewarrus*, subsp. nov., ♂ Vic., N.S.W. (alps)
- olivaceus* species group
5. *ocularis*, sp. nov., ♂ N.S.W.
  6. *olivaceus* Ohaus, ♂ N.S.W.
  7. *prasinicollis* Ohaus, ♂ Qld.(?)
  8. *queenlandicus*, sp. nov. S.Qld.,
  9. *brunneus*, sp. nov., ♂ N.S.W.
- Subtribe SCHIZOGNATHINA Ohaus
1. *Trioplognathus* Ohaus
1. *griseopilosus* (Ohaus) N.S.W.
2. *Schizognathus* Fischer
1. *mesosternalis* Ohaus N.Qld.
  2. *burmeisteri* Ohaus N.S.W., Vic., Qld.(?)
  3. *compressicornis* Ohaus S.Qld., N.S.W.
  4. *rugulosus*, sp. nov., ♂ N.S.W.
  5. *viridiaeneus* Ohaus, ♂ N.Qld.
  6. *lucidus* Ohaus S.Qld., N.S.W.
  7. *macleayi* Fischer, ♂ Qld., N.S.W.

3. *Exochogenys*, gen. nov.
  1. *nigripennis* (Blanchard), comb. nov. N.S.W., Qld.
4. *Amblochilus* Blanchard
  1. *bicolor* Blanchard S.Qld.
5. *Pseudoschizognathus* Ohaus
  1. *variicollis* Ohaus, ♂ N.Qld.
  2. *lajoyi* Ohaus Vic.
  3. *schoenfeldti* Ohaus Qld., N.S.W.
6. *Homotropus* Waterhouse
  1. *luridipennis* Waterhouse, ♂ S.Qld., Vic.(?)
  2. *testaceipennis* Ohaus ?
7. *Mesystoechus* Waterhouse
  1. *costatus*, sp. nov., ♂ S.Qld.
  2. *ciliatus* Waterhouse, ♂ Qld.
8. *Clilopocha* Lea
  1. *pachypus* (Lea), ♂ S.A.
  2. *pilosicollis* (Lea), ♂ S.A.
  3. *mandibularis* (Carne), ♂ S.A.
  4. *angularis* (Carne), ♂ Cent. Aust.
  5. *whiteae* Lea, ♂ S.A.
9. *Dungoorus*, gen. nov.
  1. *murrumbullus*, sp. nov., ♂ Qld.
10. *Minadoretus* Arrow
  1. *leucothyreus* Lea, ♂ N.Qld.
  2. *flavomaculatus* (Macleay) N.Qld.
  3. *niveosquamosus* Lea, ♀ N.Qld.
11. *Saulostomus* Waterhouse
  1. *striatus* Ohaus, ♂ Qld.
  2. *villosus* Waterhouse N.S.W., Vic., Tas.
  3. *felschei* Ohaus, ♂ ?
  4. *brunneoviridis* Lea, ♂ N.S.W.
12. *Eosaulostomus* Carne
  1. *excisus* Carne, ♂ S.A.
  2. *collaris* (Blackburn), ♂ S.A.-W.A.
  3. *norsemance* Carne, ♂ W.A.
  4. *halei* Carne, ♂ S.A.
  5. *weiskei* Ohaus N.Qld.
  6. *mimicus* (Lea), ♂ S.Qld.
13. *Amblyterus* Macleay
  1. *deuqueti*, sp. nov. N.S.W.
  2. *simplicitarsus*, sp. nov., ♂ N.S.W.
  3. *cicatricosus* (Gyllenhal) S.Qld., N.S.W.
  4. *clypealis* Ohaus, ♀ S.Qld.
  5. *tarsalis* Lea S.Qld.
  6. *bundabergensis* sp. nov., ♂ S.Qld.
  7. *tibialis* sp. nov., ♂ Qld.(?)

## Tribe ADORETINI Ohaus

1. *Adoretus* Laporte
  1. *melvillensis* Lea N.T.



## IV. CLASSIFICATION

Ohaus (1904) classified the Rutelinae on characters of the mouthparts, dividing the subfamily into two large groups, which he subsequently (1934) named the Rutelinae homalochilidae and the R. orthochilidae, according to the structure of the labrum. In the first group Ohaus placed those forms in which the labrum is horizontal, and separated from the clypeus by a suture at the base of which lies a membrane of connective tissue. To the second, he referred those forms in which the labrum is vertical, and more or less fused to the clypeus.

Ohaus (1904) placed *Mimadoretus* Arr. and *Saulostomus* Waterh. in the R. orthochilidae for, although the labrum in these genera appears horizontal when viewed externally, dissection shows that its anteroventral margin is curved backwards into the mouth cavity. He placed *Mesystoechus* Waterh. in the same group, although he later (Ohaus 1934) transferred it to a very isolated position in the R. homalochilidae (tribe Rutelini, subtribe Areodina). Meanwhile Arrow (1907) suggested its transfer to the subtribe Parastasiina. *Mesystoechus* has little in common with other genera in either subtribe, beyond the structure of its labrum, and the author (Carne 1954) has already expressed doubts concerning its classification. Species recently referred to *Eosaulostomus* (Carne 1956), a genus very closely related to *Saulostomus*, include several with vertical labra and others with labra approximating to the *Mesystoechus* type. It is evident that, as a character for group separation, the form of the labrum is not wholly reliable. In view of their close mutual relationship, and their joint affinities with other schizognathine genera, both *Mesystoechus* and *Eosaulostomus* are considered to belong to the group R. orthochilidae, tribe Anoplognathini. It may be noted that the males of all species of *Eosaulostomus*, *Mesystoechus*, and the closely related genus *Chilopocha* Lea, are forms in which the mouthparts show considerable retrogression at the expense of highly developed sensory organs; although the labrum is horizontal, the clypeolabral suture is not conspicuous as in *Anomala antiqua* (Gyll.) and *A. aeneotineta* Fairm., which are here considered to be the only rutelines occurring in Australia that are properly referred to the R. homalochilidae.

The genera *Amblyterus* MacL. and *Mimadoretus* Arr. each include species having ventral tufts of hair on the fore tarsi of the male. This character is, according to Ohaus, definitive of the neotropical tribe Geniatini (R. orthochilidae). However, the two genera are so obviously related to other endemic genera that they must be retained in the Anoplognathini and the possession by some of their species of fore tarsal hairs regarded as instances of convergent evolution.

## KEY TO THE TRIBES AND SUBTRIBES OF THE AUSTRALIAN RUTELINAE

1. Labrum horizontal, separated from clypeus by a distinct suture; mandibles terminating in 3 sharp teeth; galeae strongly toothed (R. homalochilidae) ..... Tribe ANOMALINI Péringuey
- ..... Tribe ANOMALINI Péringuey
- Labrum usually vertical, more or less fused to clypeus; if labrum horizontal, then without a distinct clypeolabral suture, mandibles not toothed at apices, and galeae small and untoothed (R. orthochilidae) ..... 2

- 2(1). Labrum rounded or with, at most, a small anteroventral process contiguous with apex of labium ..... Tribe ANOPLOGNATHINI Ohaus .... 3  
 Labrum strongly produced, its surface denticulate, its apex overhanging that of labium ..... Tribe ADORETINI Ohaus
- 3(2). Labium with an anteromedian process curved into mouth cavity ..... Subtribe ANOPLOGNATHINA Ohaus  
 Labium without such a curved process; labial disc usually flat or gently convex, rarely strongly compressed and convex in lateral profile (*Mesystoechus*, *Chilopocha*); apex truncate, rounded, bilobed, or with an obtuse median prominence, rarely (*Exochogenys*) with a flat bidentate median process ..... Subtribe SCHIZOGNATHINA Ohaus

### Tribe ANOMALINI Péringuey

Anomalini Péringuey, 1902, Trans. S. Afr. Phil. Soc. **12**: 564. Ohaus, 1918, Col. Cat. Junk **20**(66): 62; 1934, Gen. Ins. **199**A: 4.

In examining collections of Australian Rutelinae, the author found a number of specimens of various exotic anomalines. As there is no collection of the world *Anomalini* in any Australian museum, and as the study of the enormous literature on this tribe is quite outside the scope of this study, no attempt has been made to include them in this review. It seems highly probable that none are endemic species. All the specimens in question are obviously old, and that these species have not been collected again in recent times suggest that they may have been accidental introductions that have failed to persist. The specimens concerned are:

*Anomala* sp.: 1♂, "Port Darwin" (SAM).

*Anomala pallida* F. (det. Arrow): 1♂, "Swan R." (SAM). This species is otherwise known only from Java, Celebes, Amboina.

*Anomala clypeata* Arr. (?) (det. Arrow): 2♂♂, "Swan R." (SAM). This species is otherwise known only from S. Africa.

*Anomala* sp.: 1♂, "Swan R." (CSIRO).

*Anomala* sp.: 4♂♂, "N. Queensl." (MACL).

*Parastasia* sp. (?): 2♂♂, "Port Darwin" (QU).

### 1. Genus ANOMALA Samouelle

*Anomala* Samouelle, 1819, Ent. uscf. Compend. p. 191.

#### Subgenus APROSTERNA Hope

*Aprosterna* Hope, 1835, Trans. Ent. Soc. Lond. **1**: 117.

#### 1. ANOMALA (APROSTERNA) ANTIQUA (Gyllenhal)

Figs. 1, 2

*Melolontha antiqua* Gyllenhal, 1817, in Schönherr, Syn. Ins. **1**(3): 196.

*Melolontha lugubris* Wiedemeyer, 1823, Zool. Mag. **2**(1): 93.

*Mimela nigricans* Kirby, 1825, Trans. Linn. Soc. Lond. **14**: 565.

*Euchlora aerea* Perty, 1831, Col. Ind. Or. p. 34.

*Aprosterna nigricans* Hope, 1835, Trans. Ent. Soc. Lond. **1**: 117.

*Anomala australasiae* Blackburn, 1892, Proc. Linn. Soc. N.S.W. (2) **7**: 113.

Deep green or bronze-green species, 13–18 mm in length.

♂. Mentum smooth near bilobed apex. Labrum transverse, depressed at middle of lower margin. Maxilla with terminal segments of palps obovate, with large, slightly impressed dorsal sensoria. Antenna 9-segmented, club shorter than shaft.

Clypeus transverse, sides rounded from base, margin increasingly recurved anteriorly; disc glabrous, confluent punctate; ocular canthi slender, glabrous. Clypeofrontal suture transverse, weakly sinuate. Frons confluent punctate at sides, and behind suture.

Pronotum with marginal ridges continuous, basal angles obtuse, sides rounded, anterior angles normal; disc shining, with fine dense punctures and a narrow impunctate median stripe. Scutellum with punctures concentrated in submarginal garland.

Elytra with shallow annulate punctures, and abundant micropunctures; epipleurae well defined, glabrous, thickened above junction of meso- and metacoxae, obsolete near apices, with a broad membranous border posterior to level of 3rd abdominal sternite.

Fore tibia bluntly 3-dentate, surface strongly punctate; tarsus with 1st segment longer than segments 2-4 together. Larger claws of middle and fore legs toothed; those of fore legs greatly broadened (Fig. 1). Prosteronum not forming a visible postcoxal process. Hind legs slender, tibia bicarinate, with elongate distorted punctures; tarsus similarly sculptured. Thorax with short yellowish grey vestiture.

Abdomen with sparse brownish yellow hairs across mid line. Pygidium vertical, convex in profile, apex narrowly rounded, laterally compressed, glabrous except in extreme lateral angles and on ridge; disc with small but deeply impressed punctures, these transversely distorted near margins.

♀. Anterior claws toothed but not broadened (Fig. 2). Fore tarsus with 1st segment longer than segments 2-4 together. Fore tibia with basal tooth subobsolete.

*Type locality*.—"India or., Macao".

*Type location*.—NRS.

*Specimens examined*.—Type ♀ plus c. 250 (BSES; CSIRO; NM; QDAS; QM; QU; SAM; WAM).

*Distribution*.—QUEENSLAND: Ayt, Babinda, Cabramatta, Cairns, Cape York, Coen R., Cooktown, Deeral, Endeavour R., Gordonvale, Harvey's Ck., Ingham, Innisfail, Kuranda, Laura, Meringa, Mossman, Sarina, Townsville. WESTERN AUSTRALIA: Darwin, Wyndham, Kimberley Research Station, C.S.I.R.O. (near Wyndham).

This species is distributed to the north of Australia, reaching southern China.

According to Dodd (1917) the species flies at dusk between mid-November and mid-January. It is a nectar feeder, and has been recorded from the flowers of *Lantana* sp. and of the Leichhardt Tree (*Sarcocephalus cordatus* Miq.), and when in flight exudes a sweet odour. Its larvae are found in rain-forest, and in piles of organic refuse. The species shows a marked preference for red volcanic soils over clay or sandy loams. It has a one-year life cycle.



## Genus ANOMALA Samouelle, s.s.

*Anomala* Ohaus, 1916, Stettin. ent. Ztg. 77: 39.

## 2. ANOMALA AENEOTINCTA Fairmaire

*Anomala aeneotincta* Fairmaire, 1883, Ann. Soc. Ent. Belg. 27: 7.

Yellowish brown species, with head and pronotum slightly coppery, the latter with pale marginal bands. Pygidium dark brown, with 2 paramedian longitudinal yellow marks. Length 11–16 mm.

♂. Palps small, sensoria superficial. Mentum broadly depressed at apex, truncate or slightly notched in middle. Labrum setose. Antennae 9-segmented, club slightly shorter than shaft.

Head glabrous; clypeus transverse, sides slightly convergent towards apex, angles rounded, anterior margin straight, only slightly recurved; disc with confluent rugulose punctation; clypeofrontal suture transverse, very slightly curved hindwards. Frons densely punctate; ocular canthi long, slender, glabrous.

Pronotum with ridges obsolete across middle, basal angles obtuse, anterior angles normal, sides slightly rounded, surface with close fine punctures and a narrow impunctate median stripe. Scutellum punctate, glabrous; prescutellum with short yellow hairs.

Elytra with dense semi-annulate punctures; epipleurae glabrous, obsolete near apices where very broadly membranous.

Fore tibia bidentate, teeth blunt; tarsus with segment 1 shorter than segments 2–4 together; claws unequal, the larger toothed. Hind legs moderately slender, tibia longitudinally wrinkled, bicarinate; spurs slender, long, very unequal; claws simple. Claws of middle legs toothed. Thorax clothed with short golden hairs.

Abdomen very sparsely clothed on sternites, the last sternite transversely rugulose. Pygidium subvertical, weakly convex, transversely rugulose, with sparse setae across base and at apex, slightly compressed at sides, apex rounded.

♀. Antennal club slightly shorter than in ♂. Larger anterior claws toothed but smaller; fore tarsus with segment 1 as long as segments 2–4 together.

*Type locality*.—New Britain.

*Type location*.—MDN.

*Specimens examined*.—12 (CSIRO; MACL; NM; QM).

*Distribution*.—QUEENSLAND: Gordonvale, "N. Qld.". WESTERN AUSTRALIA: Moore R. NEW BRITAIN: Rabaul. NEW GUINEA: No precise localities.

## Tribe ANOPLOGNATHINI Ohaus

Anoplognathini Ohaus, 1918, Col. Cat. Junk. 20(66): 167; 1934, Gen. Ins. 199 A: 4.

## Subtribe ANOPLOGNATHINA Ohaus

Anoplognathina Ohaus, 1918, op. cit. 20(66): 168.

## KEY TO GENERA OF THE ANOPLIGNATHINA

1. Mesosternal process present, ranging in form from a short rounded process scarcely surpassing anterior margin of mesocoxae, to a large curved robust prong overlying fore coxae; posterior margin of pronotum bilobed; epipleurae non-membranous .....2
- Mesosternal process undeveloped; posterior margin of pronotum rounded as a single median lobe; epipleurae with at least a fine membranous border .....4
- 2(1). Fore tibia without, or with only a single lateral tooth; abdominal sternites with conspicuous patches of dense white hairs at extreme lateral margins. Smooth, glossy, oval, rather dytiscoid species; elytra impunctate; thoracic vestiture sparse, or short and decumbent .....3
- Fore tibia with 2 lateral teeth; abdomen without patches of white hairs at sides. Not dytiscoid in appearance; elytra usually punctate; with abundant erect thoracic vestiture ..... 3. *Anoplognathus* Leach
- 3(2). Fore tibia without lateral teeth; labium impressed at suture with submentum; pygidium transversely rugulose; hind legs of ♂ normal ..... 1. *Calloodes* White
- Fore tibia with a single lateral tooth; labium not impressed; pygidium finely punctate; hind legs of ♂ often grossly enlarged and modified ..... 2. *Repsimus* Macleay
- 4(1). Hind claws toothed; clypeus highly transverse, showing very little sexual dimorphism of shape; mouthparts robust, deeply pigmented; epipleurae with a conspicuously membranous border. Large insects (18–28 mm), colours brilliant but extremely variable .....5
- Hind claws simple; clypeus longer than broad, exhibiting appreciable sexual dimorphism of shape; mouthparts relatively weak, darkly pigmented on working surfaces only. Smaller insects (13–23 mm) of drab greenish brown or brownish yellow hue ..... 6. *Paraschizognathus* Ohaus
- 5(4). Head, pronotum, and epipleurae bearing long, erect hairs. Neither mentum nor fore tarsus of ♂ bearing specialized setae .....4. *Epichrysus* White
- Head, disc of pronotum, and epipleurae glabrous. Mentum of ♂ with oval patch of dense erect specialized setae, and with underside of first 2 fore tarsal segments similarly clothed .....5. *Anoplostethus* Brullé

## 1. Genus CALLOODES White

Figs. 3–5

*Calloodes* White, 1845, Ann. Mag. Nat. Hist. 15: 38. Olliff, 1890, Rec. Aust. Mus. 1: 72.  
 Arrow, 1901, Ann. Mag. Nat. Hist. (7)7: 396. Ohaus, 1904, Stettin. ent. Ztg. 65: 67,  
 71. Carne, 1957, Aust. J. Zool. 5: 127, 137.

Type species *Calloodes grayianus* White, 1845 (by monotypy).

Mouthparts strongly developed, as in *Repsimus*, but labium strongly impressed at suture between mentum and submentum; maxillary palp with terminal segment slender. Antenna 10-segmented, club shorter than shaft; smooth, shining, dytiscoid beetles 18–31 mm in length.

♂. Clypeus transverse, flat, with anterior margin strongly recurved but sides only slightly so; clypeofrontal suture fine, distinct, transverse; ocular canthi short, slender, sparsely setose.

Pronotum with sides slightly angulate, anterior angles produced, acute; basal angles well defined, basal margin bilobed over scutellum, both it and anterior margin with ridge obsolete at least across median third; disc without an impressed line.

Elytra with humeral angles well defined; epipleurae glabrous, non-membranous, very narrow, usually obsolete anterior to junction of meso- and metacoxae; apices usually acuminate (Fig. 5).

Fore tibia without lateral teeth, the margin straight or weakly concave; fore tarsus short, with segments 1-4 together equal in length to segment 5, the latter bent; claws subequal, simple. Hind legs almost glabrous, strongly built; tibia cylindrical, without distinct carinae, spurs sharp; tarsus stout, 5th segment with strong ventral process. Mesosternum heavily built, curved, with bluntly rounded apex overhanging fore coxae. Thorax clothed with short white hairs at sides.

Abdomen glabrous on mid line; pygidium flat, sloping, often nearly horizontal, transversely rugulose and bearing decumbent white hairs.

♀. Fore tarsus more elongate, with segments 2-4 together equal in length to both segments 1 and 5; claws toothed in *grayanus* only; fore tibia more slender, lateral margin more distinctly concave (e.g. Fig. 4). Clypeus broader than in ♂, more heavily sculptured, anterior margin less strongly recurved. Pronotum with sides more rounded, anterior angles less acute.

The generic name was first employed by White in his description of *grayanus*, but this author did not define the generic characters. These were formally stated by Arrow (1901). Several species described by Blackburn as *Calloodes* (*mastersi*, *frenchi*) were shown by Olliff (1890) to be incorrectly placed, and have been transferred to *Anoplognathus* by the present author (Carne 1957a).

A study of the biology of *Calloodes* spp. should prove most interesting, particularly as to the nature of the larval food. At least two species breed in almost pure sand in the beds of north Queensland rivers.

#### KEY TO SPECIES OF THE GENUS CALLOODES

1. Epipleurae obsolete anterior to junction of meso- and metacoxae; elytral apices acuminate; larger fore tarsal claws of ♀ simple; smaller species (18-22 mm in length) ..... 2
- Epipleurae continuous to humeral angles; elytral apices usually contiguous, never acuminate; larger fore tarsal claws of ♂ distinctly toothed. Larger species (24-31 mm in length) with broad reddish or brownish yellow marginal bands on head, pronotum, and elytra. Qld., N.W. Aust. .... 4. *grayanus* White
- 2(1). Pronotum and elytra micropunctate; abdomen widely glabrous along mid line; legs deep metallic green ..... 3
- Pronotum and elytra with discernible punctation; abdomen densely clothed with adpressed white scale-like hairs, with only a narrow glabrous median zone; legs reddish brown, femora with a green sheen. Qld. .... 3. *rayneri* Macl.
- 3(2). Lateral margins of pronotum and elytra with a reddish yellow band. N. Qld. .... 1. *atkinsoni* Waterh.
- Pronotum and elytra uniformly coloured. N. Qld. .... 2. *frenchi* Ohaus

#### 1. CALLOODES ATKINSONI Waterhouse

*Calloodes atkinsoni* Waterhouse, 1868, Ent. Mon. Mag. 5: 9. Ohaus, 1904, Stettin. ent. Ztg. 65: 73.

Green species, with clypeus reddish near margins, pygidium and undersurface deep reddish brown with a strong green sheen, the abdomen somewhat lighter than thorax. Length 18½-22 mm.



♂. Truncated face of clypeus glabrous; clypeus scarcely recurved at sides, very finely punctate on disc, most densely so in 2 lateral zones. Clypeofrontal suture transverse, weakly sinuate; frons with punctation becoming finer towards vertex. Ocular canthi almost glabrous.

Pronotum and elytra with broad marginal reddish yellow stripe; apices of elytra acuminate.

Fore tibia with setiferous fovea; claws strongly curved. Thoracic vestiture as in *frenchi*.

Abdominal sternites bearing sparse erect hairs, the last sternite glabrous in middle and not produced. Pygidium flat, narrowly rounded at apex, bearing decumbent white hairs.

♀. Fore tibia quite markedly concave in outline, appearing to have an obtuse lateral tooth.

*Type locality*.—Rockingham Bay, Qld.

*Type location*.—BM.

*Specimens examined*.—28 (CSIRO; MACL; NM; QDAS; QM; QU; SAM).

*Distribution*.—QUEENSLAND: Ayr, Cairns, Cardwell, Cooktown, Endeavour R., Gordonvale, Rockhampton. NEW GUINEA: Missima Lake (Rev. Bartlett).

Dodd (1917) records this species, in association with *Anoplostethus laetus* Rothsch. & Jord., feeding on the foliage of bloodwood (*Eucalyptus corymbosa* Sm.) at Gordonvale. The larval stage was found in almost pure sand in the bed of the Clohesy R., N. Qld.

## 2. CALLOODES FRENCHI Ohaus

Figs. 3–5

*Calloodes frenchi* Ohaus, 1912, Ent. Rdsch. **29**: 112.

*Calloodes nitidissimus* Lea, 1919, Trans. Roy. Soc. S. Aust. **43**: 242 (syn. nov.).

Synonymy based on comparison of types of each species.

Dorsal surface highly glossy as if lacquered, green, with golden to red reflections. Ventral surface, other than that of abdomen, deep green; abdomen deep reddish brown with a green sheen. Length 19–21 mm.

♂. Clypeus with sides slightly convergent, disc with patches of coarse punctures at sides and smooth elsewhere. Frons moderately punctate anteriorly, the punctures finer and sparser toward vertex.

Pronotal disc with shallow punctures at sides.

Elytra with epipleurae distinct almost to apices, becoming narrower towards the latter.

Fore tibia (Fig. 3) with setose lateral fovea almost obsolete, hairs pale reddish brown.

Abdomen widely glabrous, with decumbent hairs at sides; last sternite rugulose, bearing hairs almost to middle. Pygidium strongly produced and rounded, much of it concealed beneath elytra.

♀. Differing only in generic characters.

*Type locality*.—Coen R., Qld. (*frenchi*); Claude R., Qld. (*nitidissimus*).

*Specimens examined*.—Holotype ♂, cotype ♀ *frenchi* "Coen, Qld." (ZM); holotype *nitidissimus* "Coen R.", cotype ♀ "Claude R. 1.14. J.A.K." (SAM); 1♂, 3♀♀, "Coen" (NM); 1♀, "Moa, Banks Is., Torres Str. 11.19–1.20" (CSIRO).

### 3. CALLOODES RAYNERI Macleay

*Calloodes rayneri* Macleay, 1864, Proc. Ent. Soc. N.S.W. 1: 19. Ohaus, 1904, Stettin. ent. Ztg. 65: 73.

Closely related to *atkinsoni*. Of a similar bright metallic green but without yellowish margins to pronotum and elytra; disc with coppery to crimson sheen in oblique lighting. Length 18–21½ mm.

♂. Clypeus less transverse, with sides slightly convex in profile, the anterior margin more strongly recurved than in *atkinsoni*, and frontal punctation stronger; pronotum slightly more elongate, with abundant fine punctures, and with trace of a median impunctate stripe; basal ridge almost completely obsolete.

Fore tibia reddish brown, broad, bearing white scale-like hairs. Elytra with conspicuous punctures near epipleurae on posterior half of disc, the epipleurae denticulate; disc more distinctly punctate than in *atkinsoni*, the apices more acutely pointed. Undersurface densely clothed with white scales, except on mid line.

♀. Differing only in characters given in the generic diagnosis.

*Type locality*.—Port Denison, Qld.

*Type location*.—Two specimens (♂, ♀) labelled "Port Denison" in the Macleay Museum were selected as types by the present author.

*Specimens examined*.—Types plus 62 (BSES; CSIRO; MACL; NM; QDAS; QM; QU; SAM).

*Distribution*.—QUEENSLAND: Bowen, Brisbane, Cairns, Coen, Eidsvold, Gayndah, Gilbert R. district, Herbert R., Ingham, Laura R., Mackay, Mareeba, Mt. Molloy, Proserpine, Tully.

Dodd (1917) recorded this species from Ingham and the Lower Burdekin R. districts, as well as from various localities in southern Queensland.

### 4. CALLOODES GRAYANUS White

*Calloodes grayianus* White, 1845, Ann. Mag. Nat. Hist. 15: 38. Burmeister, 1855, Handb. Ent. 4(2): 524.

*Calloodes grayanus* Ohaus, 1904, Stettin. ent. Ztg. 65: 72.

This is the largest species of the genus and is anomalous in that the larger anterior claws of the female are toothed, as in *Anoplognathus*. Length 24–31 mm.

♂. Truncated face of clypeus short, setose at sides; disc with subobsolete confluent punctation; frons with close shallow punctures; ocular canthi with short white hairs.

Pronotum with dense shallow punctures, without a median stripe; basal margin with short white setae across whole width; sides distinctly angulate.

Elytra distinctly punctate, calli poorly defined; epipleurae very narrow, almost obsolete at apices where defined by punctures, dilated over junction of meso- and metacoxae; apices contiguous, not acuminate.

Fore tibia with lateral margin almost straight, without a setiferous fovea; thorax with rather sparse short white hairs; abdomen sparsely clothed across mid line. Hind legs stout, tibia tubular, non-carinate, spurs sharp and separated by single ciliae.

Hind margin of last abdominal sternite slightly concave. Pygidium flat, sloping, densely clothed with decumbent white hairs, and with sparse short yellowish hairs near rounded apex.

♀. Larger anterior claws distally toothed. Elytral apices individually rounded, giving rise to a small re-entrant angle.

*Type locality*.—Australia.

*Type location*.—BM.

*Specimens examined*.—52 (BSES; CSIRO; MACL; NM; QDAS; QU; SAM; WAM).

*Distribution*.—QUEENSLAND: Ayr, Bowen, Brisbane, Bundaberg, Cairns, Claire, Clermont, Clohesy R., Dimbulah, Gin Gin, Gordonvale, Hughenden, Ingham, Innisfail, Julia Ck., Kuranda, Port Denison, Proserpine, Rockhampton, Townsville, Tully. WESTERN AUSTRALIA: Canning Stock Route, Geraldton, Kimberley Research Station, C.S.I.R.O. (near Wyndham).

Girault and Dodd (1915) provided some information on the duration of the immature stages of this insect. They recorded its larvae, together with those of *C. atkinsoni*, in the dry sandy bed of the Clohesy R. Adults were taken on the foliage of *Melaleuca* sp. and *E. corymbosa* in February, March, and April. The adults lived 12–15 days and the females laid up to 28 eggs in clusters of two or three. The incubation period of the egg was about 16 days. First instar larvae were recorded from early March to the end of April; final instar larvae from late June to early September. The adults transformed from pupae as early as late October, but flights were not recorded before early February.

## 2. Genus REPSIMUS Macleay

Figs. 7–13

*Repsimus* Macleay, 1819, *Horae Ent.* 1, app. p. 144. Ohaus, 1904, *Stettin. ent. Ztg.* 65: 66, 69.

Type species *Anoplognathus brownii* Macleay 1819 (= *Rutela manicata* Swartz, 1817).

The manuscript name *Repsimus* of Leach was first published by Macleay who described two species. Macleay's remarks indicate that he did not regard *Repsimus* as distinct from *Anoplognathus* Leach, but his brief description serves to establish it. The two species he described have proved to be junior synonyms of *Rutela manicata*, published two years earlier.

♂. Labium rather elevated in middle, mentum forming a strong process curving into mouth cavity. Maxilla very strong; galea toothed, palp small and with terminal segment pyriform due to presence of a large dorsal sensorium. Mandibles with scissor-like region bent ventrally; molar area wide, finely ridged. Antenna 10-segmented, club shorter than shaft.



Clypeus highly transverse, quadrate, sides and anterior margin equally and slightly recurved, the whole only slightly narrowed towards apex. Clypeofrontal suture transverse, slightly impressed. Head glabrous, ocular canthi very slender.

Pronotum micropunctate, without trace of a median furrow, sides subparallel in posterior two-thirds, contracted towards acute anterior angles; basal and anterior margins with ridges obsolete across median third, the basal margin weakly bilobed over scutellum.

Elytra micropunctate, apices frequently acuminate, subapical calli distinct; epipleurae glabrous, not membranous.

Fore tibia with a single lateral tooth (e.g. Fig. 12); tarsus short, with segments 1-4 together equal in length to segment 5; claws slender, subequal, simple. Mesosternal process strongly developed, glabrous, flat, terminating sharply above mid point of fore coxae. Prosternum forming a small postcoxal process. Thoracic vestiture white. Hind legs almost glabrous, strongly built, often grossly thickened and with claws enlarged.

Abdomen with hind margin of last sternite evenly convex in outline. Pygidium finely punctate.

♀. Fore tibia with lateral tooth more strongly developed than in ♂; fore tarsus with both segments 1 and 5 equal in length to segments 2-4 together. Hind legs slender.

#### KEY TO SPECIES OF THE GENUS *REPSIMUS*

1. Hind legs of ♂ grossly enlarged (Figs. 10, 11); smaller species (15-21 mm in length); abdomen either glabrous or clothed with white hairs across middle ..... 2
- Hind legs of ♂ normal (Fig. 8); larger species (17-27 mm in length); abdomen widely glabrous across middle; dark purplish black forms, occasionally with a green or red sheen. N.S.W. coast and adjacent tablelands, S. Qld. .... 1. *aeneus* (F.)
- 2(1). Head and elytra purplish black, pronotum reddish brown with a dark median patch; rarely concolorous purplish black, or reddish brown; abdomen with only sparse hairs towards mid line. Coastal Vic., N.S.W., and S.Qld. . . . 2a. *manicatus manicatus* (Swartz)
- Bright green species; abdomen with conspicuous white hairs extending across sternites almost to mid line. N.S.W. southern tablelands, eastern Vic. .... 2b. *manicatus montanus* Lea

Having examined a large number of specimens of *Repsimus* from all parts of the distribution of the genus, the author is able to recognize only two species, one of which is represented by two subspecific forms. The latter are distinguished by having grossly enlarged hind legs in the male and were described as *manicatus* Swartz and *manicatus* var. *montanus* Lea. The second species is the Fabrician *aeneus*, of which *purpureipes* Mael. is a synonym. Confusion has surrounded the identity of this latter species. Ohaus regarded *aeneus* and *purpureipes* as distinct species but it appears that he misidentified the Fabrician species and the distinctions he described are actually those between *manicatus* and *purpureipes*; although the type of *purpureipes* cannot be found it is adequately described, and agrees with specimens compared with the type of *aeneus*.

*Repsimus* spp. are leaf feeders, and are seen in great numbers on individual trees where they congregate for mating. When copulating, the male of *manicatus* grasps the leaf stalk with its enormous hind claws and hangs suspended, entirely supporting the female. The tree supporting them has, at a distance, the appearance of bearing innumerable pendant green fruit. The larval stages are found in very sandy soils, sometimes almost pure sands, along river banks. *R. aeneus* is often taken in light traps.

# 1. REPSIMUS AENEUS (Fabricius)

Figs. 7-9

*Melolontha aenea* Fabricius, 1775, Syst. Ent. p. 34.

*Scarabaeus aeratus* Linnaeus, 1790, Syst. Nat. 13th Ed. 1(4): 1570.

*Repsimus aeneus* Boisdual, 1835, Voy. Astrolabe, Col. 2: 182. Ohaus, 1898, Stettin. ent. Ztg. 59: 38; 1904, op. cit. 65: 69.

*Repsimus purpureipes* Macleay, 1871, Trans. Ent. Soc. N.S.W. 2: 197. Ohaus, 1898, Stettin. ent. Ztg. 59: 38; 1901, Dtsch. ent. Z. 1901: 131 (syn. nov.).

♂. Elytra with epipleurae continuous to truncate apices, dilated over metacoxae. Fore tibiae with a lateral sinuation close to terminal tooth; fore tarsus stout, with segments 1-4 together equal in length to segment 5. Hind legs (Fig. 8) stout, with tibia tubular, spurs short, tarsus very short, with first 4 segments highly compressed, the 5th large and bearing stout unequal claws.

Abdomen with sparse, very fine pale yellow hairs scattered across sternites, in addition to dense white bristle-like hairs on pleural regions. Last sternite with posterior margin evenly curved. Pygidium with apex produced and abruptly truncate. Genitalia as in Figure 9.

♀. Epipleurae obsolete before elytral apices, the latter slightly produced. Fore tibia with a distinct lateral tooth; hind legs (Fig. 7) less strongly built, tibia expanded distally, last tarsal segment and claws much less enlarged. Last abdominal sternite with posterior margin truncate, or slightly concave.

*Type locality*.—"New Holland".

*Type location*.—Of *aeneus*, Banks Coll. (BM); of *aeratus* and *purpureipes*, unknown.

*Specimens examined*.—225 (BSES; CFD; CSIRO; NM; QDAS; QM; QU; SAM).

*Distribution*.—QUEENSLAND: Biloela, Bribie I., Brisbane, Brookfield, Byfield, Cairns, Caloundra, Childers, Chinchilla, Coen, Daintree, Eidsvold, Fletcher, Gatton, Gordonvale, Imbil, Ingham, Innisfail, Kuranda, Lawes, Miami, Mossman, Nambour, Peel I., Proserpine, Rockhampton, Rosedale, Stanthorpe, Stradbroke I. NEW SOUTH WALES: Canberra (A.C.T.), Griffith, Lismore, Maclean, Pilliga, Queanbeyan, Quirindi, Singleton, Sydney, Trangie, Tuggerah, Yass. VICTORIA: Broadford.

Dodd (1917) states that the adults feed on the foliage of bloodwood (*E. corymbosa*) at Gordonvale in December and January and also on *Eugenia tierneyana* F. Muell., especially its young foliage. The larval stages are found in sandy loams.

The author is indebted to Mr. E. B. Britton of the British Museum (Natural History) for loan of a specimen compared with the Fabrician type.

2a. *REPSIMUS MANICATUS MANICATUS* (Swartz)

Fig. 10

*Rutela manicata* Swartz, 1817, in Schönherr, Syn. Ins. 1(3): 152; op cit., app. p. 64.

Ohaus, 1904, Stettin. ent. Ztg. 65: 70.

*Repsimus bracteatus* Drapiez, 1819, Ann. Sci. Phys. Brux. 1: 135, pl. 7, fig. 6.

*Anoplognathus brownii* Macleay, 1819, Horae Ent. 1, app. p. 144.

*Anoplognathus dytiscoides* Macleay, 1819, loc. cit.

Small species, 15½–20 mm in length; head and elytra purplish black, pronotum reddish brown with a dark median patch; rarely concolorous purplish black or reddish brown.

♂. Pronotum with a few small hairs near anterior angles; anterior margin with ridge continuous across middle, disc closely asperate at sides; epipleurae obsolete just before apices.

Fore legs slender, tibia with a weak lateral tooth. Hind legs greatly enlarged, tibia triangular, tarsus (Fig. 10) highly compressed, 4th segment very wide, 5th strong, elongate and bearing very large asymmetric claws; apices of latter capable of engagement in groove on inner apex of 4th tarsal segment.

Elytra with apices truncate, or very slightly produced.

Abdomen bearing only sparse white hairs across middle. Pygidium with short inconspicuous hairs.

♀. Fore tibial tooth stronger, dorsal pronotal setae longer, elytral apices not or only scarcely acuminate. Pygidium commonly concealed beneath elytra; last sternite with deep median excision. Hind legs normal.

*Type locality*.—Of *manicatus*, "New Holland"; of *brownii* and *dytiscoides*, "Australasia"; of *bracteatus*, unknown.

*Type locations*.—Type of *manicatus* in NRS, those of Macleay species in MACL.

*Specimens examined*.—♀ type of *manicatus*, ♂ types of Macleay species, plus 48 other specimens (CFD; CSIRO; MACL; NM; QDAS; QM; QU; SAM).

*Distribution*.—QUEENSLAND: Brisbane, Brookfield, Cedar Ck., Killarney, Maryland, N. Pine R., Stanthorpe, Sunnybrook, Tambourine. NEW SOUTH WALES: Armidale, Bendemeer, Blue Mountains, Cook's R., Dorrigo, Grafton, Jervis Bay, Narara, Sydney. VICTORIA: Buxton, Marysville.

2b. *REPSIMUS MANICATUS MONTANUS* Lea, stat. nov.

Figs. 11–13

*Repsimus manicatus* var. *montanus* Lea, 1919, Trans. Roy. Soc. S. Aust. 43: 242.

This subspecies was first described by Lea as a varietal form of *manicatus* occurring on the mountainous areas of eastern Victoria and on the Mt. Kosciusko massif in New South Wales. The two forms are entirely distinct and are here regarded as subspecies.

Very close to *m. manicatus* but differing in having a consistently uniform green coloration. Elytra (Fig. 13) quite strongly acuminate; abdomen with numerous conspicuous white hairs across all sternites almost to mid line; pygidium longer and with more conspicuous vestiture; ♂ hind tibia (Fig. 11) less produced at its outer apex, 4th hind tarsal segment relatively less dilated (cf. Figs. 10 and 11).



*Type locality*.—Bright, Vic.

*Type location*.—SAM.

*Specimens examined*.—♂ type plus 180 (CFD; CSIRO; NM; SAM).

*Distribution*.—NEW SOUTH WALES: Bega, Canberra (A.C.T.), Goulburn R., Jindabyne, Lismore, Moss Vale, Mt. Kosciuszko. VICTORIA: Alexandra, Bright, Buchan, Kerrisdale, Tallarook, "Victorian Alps".

### 3. Genus ANOPLGNATHUS Leach

*Anoplognathus* Leach, 1815, Zool. Misc. 2: 43. Carne, 1957, Aust. J. Zool. 5(1): 88-143 (revision).

Since the author's revision of this genus was published, a number of additional records of distribution have been obtained and are listed below.

*A. viridiaeneus* (Donov.).—Maryborough, Qld.; Newcastle, N.S.W. (SAM).

*A. montanus* Macl.—SOUTH AUSTRALIA: Adelaide, Belair, Blackwood, Hindmarsh Valley, Reynella, Rosebrook, Tea Tree Gully, Torrens, Walkerville. VICTORIA: Black Rock (SAM).

*A. macleayi macleayi* Blackb.—2♂♂, "Alice Springs, Feb. '42, J. L. Johnson"; 2♂♂, 3♀♀, "Everard Rgs. S.A.—Warburton Rgs., W.A., 1931-32, A. Brumby"; ♀, "Skirmish Hill, W.A., 30 Apr.-8 May '56, S. Warner"; ♀, "Coniston Stn., nr. Alice Springs, N.W. Mules"; ♀, "S. Aust." ♀, "MacDonald Downs, C. A., 1933, C.O. Chalmers" (SAM).

*A. narmarus* Carne.—♂, "Mt. Painter, S. Aust."; 3♂♂, 1♀, "Mt. Serle, N. Flinders Rg., S. Aust., A. M. Morgan"; ♂, "Maree Picnic Grounds, S. Aust., 2.11.55, at lights, E. T. Giles"; 1♂, 5♀♀, "Well 4 m. E. of Oraparinna, S. Aust., 12.2.56, at lights, G. F. Gross"; 2♂♂, 5♀♀, "Wilpena Pnd., S. Aust., 9.2.56, at lights, G. F. Gross"; ♂, ditto, 10.2.56 (SAM).

*A. rugosus* Kirby.—Jenolan, N.S.W. (SAM).

*A. chloropyrus* (Drap.).—Bairnsdale, Vic. (SAM).

*A. boisdewali* Boisd.—Mansfield, Vic. (NM).

*A. punctulatus insularis* Ohaus.—♀, "Finsch Haven, N. Guinea, L. Wagner" (SAM).

*A. velutinus* Boisd.—SOUTH AUSTRALIA: Adelaide, Belair, Klemzig, Reynella, Yorke Peninsula (SAM).

*A. brunnipennis* (Gyll.).—Sydney (SAM).

*A. daemeli* Ohaus.—Herberton, Qld. (SAM).

*A. rubiginosus* Macl.—The author previously felt some doubt as to the validity of this species, of which he had seen very few specimens. Two specimens (1 ♂, 1 ♀), collected by Mr. F. Paul of Grafton at Ward's Mistake and Armidale, served to confirm it as a good species. Specimens seen previously were a deep reddish brown, without iridescence. Mr. Paul's specimens possess a brassy sheen, especially on the pronotum, similar to that of *chloropyrus*.

In the author's key to the species of *Anoplognathus* (Carne 1957a) separation of species belonging to the *suturalis* species group will be more readily achieved by substituting the following:

- 27(1). Elytral apices contiguous; basolateral angles of pronotum always glabrous; ♂ genitalia as in Figures 67, 68 ..... 28
- Elytral apices individually rounded, giving rise to a small re-entrant angle; basolateral angles of pronotum commonly setose; ♂ genitalia as in Figures 70, 71 .. *hirsutus* Burm.
- 28(27). Clypeus and anterolateral angles of pronotum with conspicuous erect white hairs ..... *suturalis* Boisd.
- Clypeus and pronotum quite glabrous ..... *rubiginosus* Macl.

## 4. Genus EPICHRYSUS White

*Brachysternus* Guérin, subgen. *Epichrysus* White, 1841, in Gray, J. Discov. Aust., app. 2, p. 460; 1842, Rev. Zool. 5: 123.

*Epichrysus* Burmeister, 1844, Handb. Ent. 4(1): 465; 1855, op. cit. 4(2): 527. Ohaus, 1904, Stettin. ent. Ztg. 65: 124.

Type species *Brachysternus (Epichrysus) lamprimoides* White, 1841 (by monotypy).

This genus is very closely allied to *Anoplostethus*, but differs in the following respects:

Mouthparts of very similar construction, but mentum of ♂ without a pad of short erect setae. Head and pronotum heavily punctate, clothed with dense long erect hairs especially in ♂; pronotum less transverse, anterior angles acute. Epipleurae bearing very long lateral setae. Fore tibia distinctly 3-dentate, tarsus lacking specialized ventral setae in ♂; larger claws of fore and middle tarsi simple. Postcoxal process of prosternum smaller, setose, closely applied to fore coxae. Thorax and abdomen densely clothed with erect hairs.

The ♀ differs from the ♂ in that all the larger claws are toothed, the pronotal vestiture confined to the margins, and the clypeus very much shorter and more coarsely pitted.

## 1. EPICHRYSUS LAMPRIMOIDES White

*Brachysternus (Epichrysus) lamprimoides* White, 1841, in Gray, J. Discov. Aust., app. 2, p. 460. Ohaus, 1904, Stettin. ent. Ztg. 65: 124.

Head and thorax bright blue-green, elytra golden green, pygidium green. Legs bluish black with a green sheen; undersurface dark green with a blue sheen. length 18–21 mm.

♂. Clypeus as in an *Anoplostethus*, strongly recurved anteriorly. Clypeofrontal suture transverse, straight; whole surface of head bearing long erect light brown hairs.

Pronotum clothed with similar hairs; anterior ridge widely obsolete, basal ridge continuous; disc with a median longitudinal furrow.

Epipleurae defined by distinct ridges, broadly membranous, and bearing long, dark brown setae.

Fore tibia broad, shallowly 3-dentate, the basal tooth quite distinct. Hind legs slender, tibia bicarinate, spurs unequal.

Pygidium convex in profile, rugulose, the disc clothed with erect grey hairs, apex rounded, the ridge and sometimes the adjacent surface with dense pale brown setae; similar setae borne on middle of hind margin of last sternite.

♀. Clypeus very much shorter than in ♂, darker, almost black. Whole head coarsely punctate, sparsely setose. Pronotum with vestiture confined to near margins. Epipleurae with setae present posteriorly only to level of mesocoxae. Fore tibia slender, more distinctly and more bluntly toothed. All larger claws toothed. Pygidium flat, contracted at sides, apex narrowly rounded, bearing relatively sparse

short white decumbent hairs, and a few longer setae near ridge; hind margin of last sternite bearing abundant setae, more numerous than in ♂.

*Type locality*.—King George Sound, W.A.

*Type location*.—BM.

*Specimens examined*.—42 (CSIRO; GFM; MACL; NM; QDAS; QM; QU; SAM; WADA; WAM).

*Distribution*.—WESTERN AUSTRALIA: Albany, King George Sound, Mt. Clarence, Nornalup.

Only one specimen was seen that deviated from the characteristic colour. This was a coppery-red individual, one of a series of 13 from Albany.

## 5. Genus ANOPLSTETHUS Brullé

Figs. 14–17

*Anoplostethus* Brullé, 1837, Hist. Nat. Ins. Col. **3**: 376. Blanchard, 1850, Cat. Coll. Ent. Col. p. 224. Ohaus, 1904, Stettin. ent. Ztg. **65**: 67, 119.

*Anoplosternus* Guérin, 1838, Voy. Favorite, Ins. p. 59. Burmeister, 1844, Handb. Ent. **4**(1): 463.

*Panschizus* Blackburn, 1888, Trans. Roy. Soc. S. Aust. **10**: 51.

Type species *Anoplostethus opalinus* Brullé, 1837 (by monotypy).

Large (19–28 mm in length) robust insects, often of spectacular and most variable colouring.

♂. Labium with anterior margin strongly produced and curved into mouth cavity, as in *Repsimus*; mentum (e.g. Fig. 16) with an oval patch of dense erect setae (except in *roseus*). Labial palp with terminal segment strongly curved. Maxillary palp with terminal segment pyriform. Antenna 10-segmented, club much shorter than shaft.

Clypeus highly transverse, angles rounded, margins recurved. Clypeofrontal suture transverse with a weak median node, fine but distinct. Head punctate, glabrous except sometimes on ocular margins.

Pronotum with anterior ridge obsolete across median two-thirds, basal ridge almost or quite continuous, basal margin produced as a simple lobe over scutellum, disc punctate.

Elytra with small deeply impressed punctures, intervals punctate; epipleurae practically glabrous, broadly membranous.

Fore tibia with 2 lateral teeth, basal tooth very small, sometimes barely discernible. Fore tarsus (e.g. Fig. 15) with 1st and 2nd segments equal in length, bearing dense ventral tufts of fine hair (except in *roseus*). Prosternum forming a conspicuous truncate postcoxal process. Mesosternal process not developed. Hind legs slender, tibia bicarinate, spurs most unequal (e.g. Fig. 14), the larger claws toothed (except in *roseus*). Those of middle legs toothed but often barely discernible.

Pygidium transversely or concentrically rugulose; abdomen and thorax bearing white hairs or scales.

♀. Mentum lacking a setal pad. Proximal fore tibial tooth more distinct; fore tarsus with 1st segment longer than 2nd and bearing normal vestiture only. The larger claws toothed on all legs, except in *roseus*. Hind tibial spurs as in Figure 17.



## KEY TO SPECIES OF THE GENUS ANOPISTETHUS

1. Margins of pronotum bearing setae dorsally; abdominal sternites with abundant white hairs. Central and southern coastal regions of W.A.; also N.Qld. .... 1. *opalinus* Brullé
- Margins of pronotum glabrous ..... 2
- 2(1). Pygidium densely clothed with adpressed white scales; elytral apices acuminate. N.T., N.Qld. .... 2. *roseus* Blanch.
- Pygidium with sparse erect hairs; elytral apices non-acuminate. N.Qld.; also S.W. Aust. .... 3. *laetus* Rothsch. & Jord.

## 1. ANOPISTETHUS OPALINUS Brullé

## Fig. 14

*Anoplostethus opalinus* Brullé, 1837, Hist. Nat. Ins. Col. 3: 376.

*Panschizus pallidus* Blackburn, 1888, Trans. Roy. Soc. S. Aust. 10: 51.

Large beetles, 24–30 mm in length, usually of a drab grey-green, with green or pink opalescence in oblique lighting.

♂. Clypeofrontal suture transverse, almost straight; frons bearing white hairs on ocular margins.

Pronotum with sides angulate at mid point, bearing lateral setae on ridges, anterior angles acute, basal ridge bearing decumbent white hairs; disc with a distinct median furrow and numerous fine punctures, the latter confluent at sides and in anterior angles where sometimes sparsely setose.

Elytra with epipleurae not defined by ridges, with decumbent white hairs at base, and a few short white hairs just at apices; thorax clothed with long erect white hairs.

Pygidium with coarse, irregular, transverse rugulosity; apical ridge greatly broadened in middle and clothed with dense yellowish hairs; similar hairs borne on hind margin of last abdominal sternite.

♀. Pygidium less convex in profile, with rugulosity partly effaced.

*Type locality*.—Of *opalinus*, "Nouvelle Hollande occidentale"; of *pallidus*, "W.A."

*Type location*.—Of *opalinus*, MDN; of *pallidus*, BM.

*Specimens examined*.—61 (CSIRO; GFM; MACL; NM; QDAS; QM; QU; SAM; WADA; WAM).

*Distribution*.—WESTERN AUSTRALIA: Boyanup, Brickley, Cannington, Carnarvon, Dwellingup, Guildford, Hamel, Harvey, Jarrahdale, Karridale, Midland, Perth, Victoria Park, Waroona, Worsley. NORTHERN TERRITORY: Raffle's Bay. QUEENSLAND: Kuranda.

Ohaus (1904) inferred that he had seen the type specimens of *opalinus* and described them as being grey-green in colour. He also mentioned specimens that were dorsally light blue-green, yellowish green, brownish green, and black. The author has also seen bright green, light tan, and dark brown examples. There appears to be no relation between the colour of the insects and their locality. The Kuranda specimens are dark brown, but the same form is seen from Perth and Carnarvon, while three distinct colour forms have been seen from Hamel.

2. *ANOPLOSTETHUS ROSEUS* Blanchard

*Anoplostethus roseus* Blanchard, 1850, Cat. Coll. Ent. Col. p. 224; 1855, Voy. Pole Sud, Zool.

4: 112. Ohaus, 1904, Stettin. ent. Ztg. 65: 122.

*Anoplostethus opalinus* Hombroen & Jacquinet (nec Brullé), 1842, Voy. Pole Sud, Zool. Col. Atlas, pl. 8, fig. 1.

Smaller than its congeners (19–24 mm in length), dull greyish fawn dorsally; margins of pronotum and epipleurae faint green, elytral apices mauve, undersurface including pygidium and femora golden with green or red reflections; tibiae metallic red, tarsi dark reddish brown.

♂. Mentum without specialized hairs but with sparse adpressed white scales at sides; eyes very large, hemispherical in outline; clypeus evenly and moderately recurved, disc with punctures heavily impressed but discrete, clypeofrontal suture curved slightly forwards; head glabrous except for sparse white scales on ocular margins of frons.

Pronotum highly transverse, sides angulate at middle, basal and anterior margins obsolete across middle, the latter widely so and with a few small white scales behind each eye; disc faintly microreticulate, strongly punctate, with a narrow impunctate median stripe. Scutellum impunctate.

Elytra with small dark deeply impressed punctures, these not forming striae; epipleurae bearing sparse white hairs near humeral angles, obsolete from level of propygidium to slightly acuminate elytral apices, the elytral margin there conspicuously membranous; subapical calli well defined.

Fore tibia with the basal tooth very small and sometimes subobsolete, the other teeth long and sharp; tarsi of all legs with segments 1–4 together as long as segment 5, the latter with a strong ventral notch and bearing long slender sharp subequal claws. Thorax clothed with short adpressed white scales, and short recumbent white hairs. Hind legs slender, tibiae tubular, without distinct carinae, sparsely clothed with white scales and sharp red ciliae; spurs unequal, sharp, separated by 3 ciliae.

Abdomen widely glabrous across middle, with white scales at sides, these becoming increasingly dense towards margins; pygidium sloping, flat, densely clothed with scales, with numerous erect yellow hairs near rounded apex, and a few similar hairs on posterior part of disc.

♀. Clypeus slightly less strongly recurved; eyes much less protuberant, less strongly curved in profile. Pronotum with basal ridge continuous, disc without a median impunctate stripe. Hind legs stronger, tibiae dilated posteriorly and with distinct carinae; spurs separated by c. 6 ciliae. All claws simple.

In one ♀ examined, the fawn pigment is lacking in irregular patches and is there replaced by a dark red. The specimen described by Ohaus was apparently uniformly red on its dorsal surface.

*Type locality*.—"Rafle's Bay, Nouvelle Hollande septentrionale" (N.T.).

*Type location*.—MDN.

*Specimens examined*.—♀, "1643", ♀, "N.T." (NM); ♀, "Pine Ck., N.T.", ♂, "2792, N.T." (SAM).

Ohaus (1904) also records this species from Cardwell, Qld.

3. *ANOPLOSTETHUS LAETUS* Rothschild & Jordan

Figs. 15-17

*Anoplostethus laetus* Rothschild and Jordan, 1894, Novit. Zool. 1: 507, pl. 13, fig. 13.

Ohaus, 1904, Stettin. ent. Ztg. 65: 122.

*Anoplostethus laetus* var. *nobilis* Benderitter, 1924, Bull. Soc. Ent. Fr. 1924: 137.

Large beetles, 24-30 mm in length, characteristically a shining light green. Closely related to *opalinus*, but differing in the following respects:

Clypeofrontal suture curved slightly forwards, with a small median node; ocular margins of frons glabrous.

Pronotum with margins glabrous, the side less angulate, disc without a median furrow.

Elytral punctures less heavily impressed; epipleurae clearly defined by ridges, glabrous.

Fore tibia with basal tooth nearly or quite obsolete. Thorax with very sparse short vestiture.

Pygidium with sculpture consisting of concentrically disposed small tubercles; apical ridge not broadened in middle; both this and hind margin of last abdominal sternite with only sparse hairs.

*Type locality*.—Cardwell, Qld.

*Type location*.—Ohaus Collection (ZM).

*Specimens examined*.—77 (AM; BSES; CSIRO; MACL; NM; QDAS; QM; QU; SAM).

*Distribution*.—WESTERN AUSTRALIA: Bunbury, Geraldton, Hamel. QUEENSLAND: Cairns, Cardwell, Gordonvale, Innisfail, Johnston R., Kuranda, Mt. Fox, Tully.

As with *opalinus*, colour variation is considerable and bears no relation to locality. Ohaus (1904) refers to the green form as characteristic, and to having seen one specimen that is a bright red. Dodd (1917), referring to a collection of 245 specimens from Cairns and Innisfail, states that 81 per cent. were green, 10 per cent. violet, and 9 per cent. red. The author has seen, in addition, dull brown, pinkish green, pinkish violet, and mauve individuals. Dodd also records that the distribution of this species in Queensland is very local, and that it is found feeding on the leaves of *E. corymbosa* at Cairns from December to February.

6. Genus *PARASCHIZOGNATHUS* Ohaus

Figs. 18-73

*Paraschizognathus* Ohaus, 1904, Stettin. ent. Ztg. 65: 67, 125.

Type species *Schizognathus prasinus* Boisduval, 1835 (here selected).

Greenish or yellowish brown species, 13-23 mm in length, rather strongly convex, pronotum smooth but elytra rather heavily and irregularly punctate.

Mentum (e.g. Figs. 34, 36) strongly pigmented at apex and forming a small process curved into mouth cavity; labial palp sickle-shaped. Maxillary palp elongate, the terminal segment often greatly enlarged and bearing a conspicuous dorsal sensorium (e.g. Fig. 35). Mandibles with scissorial area simple (e.g. Fig. 42). Antenna 10- or 9-segmented, the club variable in size.



♂. Clypeus with sides slightly curved or straight, parallel or convergent, anterior margin more strongly recurved than sides. Clypeofrontal suture sometimes obscure in middle, more often distinct and with a weak, posteriorly directed median node, the latter extended by a poorly defined ridge on frons. Frons more or less triangularly flattened.

Pronotum finely punctate, with a weak median impunctate line; lateral margins continuous, basal margin rounded and not bilobed, anterior angles obtuse. Elytra with separate striae scarcely distinguishable, the intervals irregularly punctate, the punctures shallow but the surface between them somewhat wrinkled; epipleurae narrowly membranous and bearing lateral setae almost to apices. Fore tibia 3-dentate; tarsus short, segments 1-4 together as long as segment 5, the claws large, unequal, simple, the larger with weak longitudinal striation. Thorax bearing abundant long hairs; postcoxal prosternal process present but usually concealed by dense hairs; mesosternal process not developed.

Abdomen clothed with decumbent pale hairs; pygidium flat or weakly convex in profile, disc with fine transverse rugulosity, bearing short decumbent hairs on disc and longer more erect hairs near apex.

♀. Clypeus quadrangular, with angles rounded, or with free outline convex. Antennal club always shorter than in ♂. Fore tarsus with segment 1 longer than in ♂, equal in length to segment 5, and to segments 2-4 together. Anterior claws smaller, the larger distally toothed.

#### KEY TO MALES OF THE GENUS *PARASCHIZOGNATHUS*

1. Antenna with club shorter than shaft, scarcely longer than last segment of maxillary palp; the latter with deeply impressed dorsal sensorium (e. g. Figs. 35, 39) ..... 2  
.....(*prasinus* species group)
- Antenna with club longer than shaft, very much longer than last segment of maxillary palp; the latter with sensorium not deeply impressed ..... 5  
.....(*olivaceus* species group)
- 2(1). Antenna 10-segmented ..... 3  
Antenna 9-segmented. Fore tibial teeth deeply separated, lying at small angle to axis of tibia as a whole (Fig. 59); anterior margin of clypeus considerably narrower than clypeofrontal suture (Fig. 26); green species, with white or greyish thoracic villosity. Length 15-17 mm.  
Outline of head as in Figure 26; ground colour light green. Mt. Gingera, N.S.W. .... 4a. *elgatus elgatus*, sp. nov.  
Outline of head as in Figure 27; ground colour dark green. Mt. Kosciusko area, N.S.W.; Bogong High Plains, Vic. .... 4b. *elgatus kiewarrus*, subsp. nov.
- 3(2). Epipleurae glabrous near elytral apices, elytral surface quite glabrous; thoracic vestiture white or greyish yellow; body green or light brownish green dorsally ..... 4  
Epipleurae setose almost to apices, elytral surface with at least a few long hairs near margins, especially below subapical calli; thoracic vestiture brownish yellow; body a dark brownish green dorsally, elytra darker than pronotum; fore tibia as in Figure 57. Length 15½-19 mm. Tubrabucca, N.S.W. .... 3. *tubrabuccae*, sp. nov.

- 4(3). Fore tibial teeth sharp, equidistant (Fig. 54); smaller species ( $15\frac{1}{2}$ – $19\frac{1}{2}$  mm in length) with molar areas of mandibles weakly pigmented and devoid of ridges, surface of clypeus smooth between punctures, anterior pronotal margin glabrous. N.S.W. coast and adjacent ranges ..... 1. *prasinus* (Boisd.)
- Fore tibial teeth bluntly rounded, unequally spaced (Fig. 55); larger species ( $18\frac{1}{2}$ – $21\frac{1}{2}$  mm), with molar areas of mandibles deeply pigmented and strongly ridged, surface of clypeus minutely rugulose between punctures, anterior pronotal margin bearing hairs. Barrington Tops, N.S.W. .... 2. *pinarus*, sp. nov.
- 5(1). Clypeus with disc setose; eyes protuberant ..... 6
- Clypeus with disc glabrous; eyes normal ..... 7
- 6(5). Fore tibial teeth (Fig. 61) equidistant; clypeus (Fig. 28) elongate (width/length ratio 1.5–1.7), clypeofrontal suture impressed. Length 16– $17\frac{1}{2}$  mm. Dorrigo, N.S.W. .... 5. *ocularis*, sp. nov.
- Fore tibial teeth (Fig. 62) unequally spaced, median tooth closer to distal than to proximal tooth; clypeus (Fig. 29) short (width/length ratio 1.8–2.0); clypeofrontal suture a fine superficial line. Length  $14\frac{1}{2}$ –17 mm. Bellingen, Dorrigo, N.S.W. .... 6. *olivaceus* Ohaus
- 7(5). Clypeus (Fig. 30) with sides parallel. Brownish green species, c.  $15\frac{1}{2}$  mm in length. Locality unknown ..... 7. *prasinicollis* Ohaus
- Clypeus with sides convergent, as in Figure 31 ..... 8
- 8(7). Clypeus with sides straight, anterior angles clearly defined (Fig. 31). Brownish yellow species,  $13\frac{1}{2}$ –15 mm in length. Cooroy, Qld. .... 8. *queenslandicus*, sp. nov.
- Clypeus with sides curved, anterior angles obtuse and poorly defined. Reddish yellow species, c.  $14\frac{1}{2}$  mm in length. Kincumber, N.S.W. .... 9. *brunneus*, sp. nov.

## KEY TO THE KNOWN FEMALES OF THE GENUS PARASCHIZOGNATHUS

1. Antenna 10-segmented; proximal and median fore tibial teeth not separated by deep, narrow angles ..... 2
- Antenna 9-segmented; proximal and median fore tibial teeth separated by deep, narrow angles (Fig. 60); clypeus and margins of frons setose; length c. 17 mm ..... 4a. *elgatus elgatus*, sp. nov.
- 2(1). Clypeus setose, its sides parallel at least in proximal quarter ..... 3
- Clypeus glabrous, its sides convergent from base. Length c. 14 mm. Qld. .... 8. *queenslandicus*, sp. nov.
- 3(2). Clypeus with sides parallel in proximal two-thirds; pronotum with erect hairs across anterior margin. Length c.  $22\frac{1}{2}$  mm. Barrington Tops, N.S.W. .... 2. *pinarus*, sp. nov.
- Clypeus with sides parallel in proximal quarter at most, or briefly convex in profile ..... 4
- 4(3). Distal and median fore tibial teeth shallowly separated (Fig. 58); vertex distinctly punctate; elytra greenish brown. Length 19– $19\frac{1}{2}$  mm. Tubrabucca, N.S.W. .... 3. *tubrabuccae*, sp. nov.
- Distal and median fore tibial teeth deeply separated; vertex smooth, impunctate; elytra light green. Length  $15\frac{1}{2}$ – $18\frac{1}{2}$  mm. N.S.W. coastal districts ..... 1. *prasinus* Ohaus

## 1. PARASCHIZOGNATHUS PRASINUS (Boisduval)

Figs. 18–22, 34, 54, 67

*Schizognathus prasinus* Boisduval, 1835, Voy. Astrolabe, Col. 2: 184.*Paraschizognathus prasinus* Ohaus, 1904, Stettin. ent. Ztg. 65: 130.

The identity of this species cannot be established beyond all doubt, as the type cannot be traced and Boisduval's description could apply to a number of species

of this genus. The species here discussed is that recognized as *prasinus* by previous authors, and it is the most common species in coastal areas.

Light apple-green to dark brownish green species, margins pale reddish yellow, legs and coxae brown, with a green sheen. Length  $15\frac{1}{2}$ – $19\frac{1}{2}$  mm.

♂. Mentum as in Figure 34. Clypeus with moderately deep almost glabrous truncated face (Fig. 18), sides slightly recurved, anterior margin strongly so, disc flat, bearing short erect fine hairs, the surface coarsely but not quite confluent punctate. Clypeofrontal suture subobsolete, transverse, with a slight posteromedian node. Ocular canthi with pale brownish yellow setae. Frons setose on anterior half, and on ocular margins. Maxillary palp conspicuous, with terminal segment large, curved, pointed and with broad sensorium occupying its entire dorsal surface. Antenna 10-segmented, club subequal in length to shaft, or slightly shorter.

Pronotum with sides evenly rounded or subangulate; disc with sparse shallow punctures, these becoming denser towards extreme lateral margins, with a narrow median impunctate stripe and two paired lateral impressions. Scutellum sparsely punctate posteriorly, more densely so anteriorly where overlaid by abundant yellow prescutellar hairs. Elytra shining, with small deeply impressed punctures; epipleurae bearing strong lateral hairs. Fore tibial teeth (Fig. 54) equidistant, proximal tooth sometimes subobsolete. Thoracic clothing white. Hind legs slender, femur bearing long white hairs, tibia 2–3 carinate, ciliae reddish brown, long, and sharp.

Abdominal sternites sparsely clothed with white hairs; pygidium variable in convexity, with short white decumbent hairs on disc, and longer erect pale yellow hairs near subtruncate apex. Genitalia as in Figure 67.

♀. Clypeus (Fig. 22) rounded, with margins more evenly recurved than in ♂, the anterior face setose and much shorter. Maxillary palp smaller, antennal club shorter than shaft. Clypeofrontal suture quite distinct, slightly angulate at mid point. Fore tibial teeth more acute. Pronotal punctation coarser. Pygidium with poorly defined median line.

*Type locality*.—"Nouvelle Hollande".

*Type location*.—Unknown.

*Specimens examined*.—97 (AM; BM; CSIRO; FEW; NM; QDAS; QM; QU; SAM).

*Distribution*.—NEW SOUTH WALES: Bellingen, Blackheath, Blue Mountains, Dorrigo, Ebor, Gosford, Lawson, Leura, Manly, Mt. Wilson, National Park, Sydney, Ulong. VICTORIA: "Gippsland". Ohaus (1904) also records the species from Melbourne, Vic., and Cape York, N.Qld.

The morphology of this species is somewhat variable and it seems probable that subspeciation is in progress as between coastal and mountain localities. Ohaus states that in specimens from Melbourne the clypeus is narrowed anteriorly and the proximal fore tibial teeth well developed, whereas in specimens from Sydney and Queensland, the sides of the clypeus are more nearly parallel, and the proximal fore tibial teeth weak. The author has only seen one specimen from other than New South Wales localities, but a similar morphological variation is observable between series from coastal and mountain localities. In specimens from the Blue Mountains the clypeus is as in Figure 19, the sides slightly dilated proximally, then



contracted, and finally dilated again at the recurved anterior margin, the latter being almost or quite as wide as the clypeofrontal suture; the body is a light apple-green dorsally, the cephalic hairs white or pale yellow, and the pronotal punctation relatively fine and sparse. Specimens from lower-lying areas (e.g. Sydney, Gosford) have the sides of the clypeus convergent (Figs. 20, 21), so that the anterior margin is distinctly narrower than the suture, the body dorsally a darker green, often suffused with a muddy brown, the cephalic hairs darker, ranging from yellow to reddish brown, and the pronotal punctation relatively denser and more heavily impressed. Considerable overlap exists between the ranges of variation of series from different localities and the population has probably not, as yet, become broken into discontinuous segments.

## 2. *PARASCHIZOGNATHUS PINARUS*, sp. nov.

Figs. 23, 24, 35–38, 53, 55, 68

This species has been misidentified in several Australian collections as *prasini-collis* Ohaus. It is similar in colour to *prasinus*, but is considerably larger.

♂. Length  $18\frac{1}{2}$ – $21\frac{1}{2}$  mm. Antenna 10-segmented, club slightly shorter than shaft. Terminal segment of maxillary palp (Fig. 35) shorter than in *prasinus*, but with a large dorsal sensorium. Maxilla as in Figure 37; mentum, Figure 36.

Clypeus (Fig. 23) elongate, with sides almost or quite parallel, scarcely recurved, edges rounded; anterior margin recurved, truncated face deep, glabrous, disc and anterior portion of frons with dense erect golden hairs, the surface finely rugulose except on vertex.

Pronotum smooth, shining, with sparse lightly impressed punctures, and a weakly impressed median impunctate stripe and paired pigmented lateral patches; surface slightly rugulose near lateral margins, the sides subangulate, anterior margin and adjacent surface bearing erect hairs. Scutellum almost impunctate at apex, with a weak tuft of golden prescutellar hairs. Elytra slightly compressed at sides. Fore tibia (Fig. 55) with teeth borne at a wide angle to major axis of tibia, median tooth closer to distal than to proximal tooth. Thoracic clothing yellowish grey. Hind tibia 3 or 4-carinate.

Abdomen with sparse golden hairs across mid line, denser at sides. Pygidium flat, transversely rugulose, with rather dense decumbent fine pale yellow hairs, and longer yellowish brown marginal hairs; sides weakly compressed, lateral angles not impressed. Genitalia as in Figure 68.

♀. Length c.  $22\frac{1}{2}$  mm. Clypeus (Fig. 24) elongate, with angles rounded and margins weakly recurved, disc with coarse confluent punctation, clypeofrontal suture transverse, weakly sinuate; frons with setiferous punctures anteriorly and on ocular margins. Maxillary palp slender, short, terminal segment with a narrow dorsal sensorium. Antenna as in Figure 38. Pronotum and elytra as in ♂. Fore tibia more evenly and strongly toothed, tarsus as in Figure 53; hind legs shorter, tibia bicarinate, spurs blunt and short. Pygidium with a median impunctate zone; last abdominal sternite more densely clothed.

*Type locality*.—Barrington Tops, N.S.W.

*Specimens examined*.—Holotype ♂, "B. Tops, Jan. 25, S.U. Zoo. Exp." (CSIRO). Two paratype ♂♂ with identical labels (MACL; QU). One paratype ♀, "Barrington Tops, N.S.W., T.G. Campbell, 21.1.27, K60166" (AM). An additional specimen in the AM has the same label data as the ♀ paratype; it is a colour variant, of a uniform light tan dorsally.

The trivial name is derived from an aboriginal word meaning "near".

### 3. PARASCHIZOGNATHUS TUBRABUCCAE, sp. nov.

Figs. 25, 39, 40, 57, 58, 69

?*Paraschizognathus prasinus* var. *nigricans* Ohaus, 1904, Stettin. ent. Ztg. 65: 131.

Closely related to *prasinus*, and superficially similar to *P. elgatus kiewarrus*.

Greenish brown dorsally, the elytra very dark brown, legs and abdomen brownish yellow, undersurface with yellowish grey to brownish yellow hairs, pygidium greenish yellow. Length  $15\frac{1}{2}$ – $19\frac{1}{2}$  mm.

♂. Antenna 10-segmented, club and shaft subequal in length. Maxillary palp (Fig. 39) with terminal segment enlarged, bearing a broad deeply impressed oval sensorium. Mentum as in Figure 40.

Clypeus (Fig. 25) with truncated face moderately deep, sparsely setose; sides parallel just anterior to ocular canthi, then convergent towards recurved anterior margin; disc, anterior part of frons, and ocular margins confluent punctate, rugulose, and bearing erect pale brownish yellow hairs. Clypeofrontal suture with a weak posteromedian node extended on to frons as a slight longitudinal ridge.

Pronotum with sides rounded, disc glabrous, shining, rather densely punctate, with a distinct median line and very shallow pigmented lateral impressions. Scutellum almost impunctate, partly concealed by dense tuft of yellow prescutellar hairs. Elytra smooth, shining, with quite distinct punctate striae; epipleurae conspicuously setose almost to apices, with a few shorter setae borne dorsally on humeral angles and subapical calli. Fore tibia (Fig. 57) slender, median tooth closer to distal than to proximal tooth, all teeth confined to anterior half of tibia. Thorax clothed with pale yellow hairs. Hind legs slender; tibia unicarinate.

Abdomen rather abundantly clothed, especially at sides. Pygidium gently convex in profile, densely clothed with fine pale yellow hairs, intermixed with less numerous but longer brownish yellow hairs, apex narrowly truncate, sides compressed. Genitalia as in Figure 69.

♀. Antennal club shorter than shaft, terminal segment of maxillary palp shorter and narrower than in ♂. Clypeus subquadrate, sides convergent, angles rounded, margins evenly recurved. Fore tibia as in Figure 58. Hind tibial spurs short and blunt, tibia 2–3 carinate. Pygidium variable in convexity.

*Type locality*.—Tubrabucca, N.S.W.

*Specimens examined*.—Holotype ♂, allotype ♀, 10 paratype ♂♂, 1 paratype ♀, "Tubrabucca, N.S.W. 10–23.1.48, R.T.M.P. & A.N.B."; 5 paratype ♂♂, "Tubrabucca, N.S.W., 28.12.46, A.N.B." (N.M.).

4a. *PARASCHIZOGNATHUS ELGATUS ELGATUS*, sp. nov.

Figs. 26, 59, 60

Pure green dorsally, with reddish margins. Related to *tubrabuccae* but differing in characters of the antenna and fore tarsus. Length 15–17 mm.

♂. Antenna 9-segmented, club slightly shorter than shaft; maxillary palp large, terminal segment with deeply impressed sensorium.

Clypeus (Fig. 26) with truncated face moderately deep, setose; sides slightly curved or parallel at base, distally convergent, slightly recurved; disc, anterior part of frons, and ocular margins bearing erect reddish brown hairs, surface with subconfluent punctures interspersed with micropunctures. Clypeofrontal suture posteriorly angulate, sometimes extended by a ridge on to frons. Ocular canthi bearing abundant brownish yellow hairs. Eyes black.

Pronotum with sides rounded, lateral impressions slight, conspicuously pigmented; disc with distinct median line, and fairly dense lightly impressed punctures becoming subconfluent towards margins; lateral thirds with areas of micropunctuation. Scutellum more or less impunctate at apex, with a conspicuous tuft of yellow pre-scutellar hairs.

Elytra with epipleurae poorly defined, bearing abundant long hairs, these brownish and appreciably darker than silky white hairs clothing thorax; subapical calli and humeral angles bearing sparse hairs; disc micropunctate, with fairly distinct punctate striae.

Fore tibia (Fig. 59) slender, teeth equidistant, median and distal tooth separated by an acute re-entrant angle.

Abdomen with dense white hairs across all sternites. Pygidium subvertical, weakly convex in lateral profile, clothed with semidecumbent fine white hairs, and numerous long erect brown hairs, the latter tending to yellowish brown near margins; apex rounded, not truncate; disc with close shallow punctures and micropunctures, and with a narrow impunctate median stripe.

Hind legs slender, tibia bicarinate, spurs separated by 2–3 ciliae.

♀. Maxillary palp with terminal segment shorter and narrower than in ♂. Clypeus more or less rounded, with margins more evenly recurved, surface elevated in middle near clypeofrontal suture where vestiture most conspicuous; fore tibia as in Figure 60; hind tibial spurs separated by 3–4 ciliae. Pygidium with erect pale yellow hairs.

*Type locality*.— Mt. Gingera, A.C.T.

*Specimens examined*. Holotype ♂ and 2 paratype ♂♂. "Mt. Gingera, A.C.T., 6,000 ft., 11.2.53, I.F.B. Common"; paratype ♂, loc. cit. "5,500 ft. 20.2.52"; paratype ♂, loc. cit. "4.2.53"; paratype ♂, loc. cit. "K.H.L. Key"; paratype ♂, "Kiandra, N.S.W., Alpine Ck., Jan. '33, H. J. Willings"; paratype ♂ and allotype ♀, "Tuggerah, Jan. 1925, M. Fuller" (mislabelled?) (CSIRO).

The trivial name is derived from an aboriginal word referring to high mountains.



4b. *PARASCHIZOGNATHUS ELGATUS* KIEWARRUS, subsp. nov.

Fig. 27

♂. Very close to *P. e. elgatus*, but the head (Fig. 27) with sides straighter, and less strongly convergent anteriorly; body a darker green; pronotum with anterior angles more pronounced; pygidium compressed at sides.

♀. Unknown.

*Type locality*.—Bogong Plains, Vic., 5000–6000 ft.

*Specimens examined*.—Holotype ♂ and paratype ♂, "Bogong Plains, 5,000–6,000 ft., Jan. '28, F. E. Wilson" (FEW); paratype ♂, "Upper Tooma R., 4,600 ft., N.S.W., 31.1.57, J. Sedlacek" (JS).

The subspecific name is derived from an aboriginal word meaning "dark".

5. *PARASCHIZOGNATHUS OCULARIS*, sp. nov.

Figs. 28, 61, 70

Dull yellowish brown dorsally, with green tinge; sometimes a clear yellowish green. Clypeus with disc lighter, margins tending to black; clypeofrontal suture reddish yellow, undersurface brownish yellow. Length 16–17½ mm.

♂. Mentum with apical process strongly pigmented; palps slender; terminal segment of maxillary palp with shallow sensorium occupying two-thirds of its length. Antenna 10-segmented, club slender, equal in length to shaft, densely setose on inner face.

Clypeus (Fig. 28) of the *queenslandicus* type (Fig. 31), sides straight, narrowing towards truncate and recurved anterior margin, and slightly dilated there; truncated face setose; disc and ocular margins of frons with erect brownish yellow hairs, surface with large shallow irregular confluent punctures; clypeofrontal suture transverse, slightly sinuate; frons flattened, with vague median ridge, vertex finely punctate; ocular canthi curved. Eyes protuberant.

Pronotum with sides rounded, basal angles obtuse, anterior angles almost so; disc with small dense punctures and an impressed median line. Thoracic villosity abundant, brownish yellow.

Elytra with epipleurae rather conspicuously membranous near apices, disc shining, with small shallow punctures and weak transverse wrinkles.

Fore tibia (Fig. 61) slender, median tooth closer to distal than to proximal tooth, sparsely setose near lateral margins, elsewhere with shallow oval punctures and microreticulation; larger claws scarcely striated. Prosternum forming a small vertical triangular postcoxal process, setose, and closely applied to fore coxae. Hind legs slender, tibia bicarinate, with scattered ciliae proximally; spurs long, sharp, separated by 2 ciliae.

Abdomen with moderate to sparse clothing. Pygidium subvertical, briefly truncate at apex, disc with decumbent yellow hairs, and larger erect hairs near margins, disc with transversely distorted punctures except on narrow zone extending from centre of disc to progypidium. Genitalia as in Figure 70.

♀. Unknown.

*Type locality*.—Dorrigo, N.S.W.

*Specimens examined*.—Holotype ♂, "Dorrigo" (NM); 2 paratype ♂♂, "Dorrigo, 5.12.11, R.J.T." (QM); paratype ♂, "Dorrigo, Heron, 12.29" (CSIRO); paratype ♂, "Dorrigo, N.S.W., W. Heron" (SAM).

## 6. PARASCHIZOGNATHUS OLIVACEUS Ohaus

Figs. 29, 41–44, 62, 71

*Paraschizognathus olivaceus* Ohaus, 1904, Stettin. ent. Ztg. **65**: 132.

Dull yellowish brown species,  $14\frac{1}{2}$ –17 mm in length.

♂. Antenna (Fig. 43) 10-segmented, club elongate, subequal in length to shaft; terminal segment of maxillary palp (Fig. 44) slender with linear sensorium occupying only half its length. Mentum as in Figure 41.

Clypeus (Fig. 29) rather short, somewhat rounded, scarcely more recurved in front than at sides; truncated face short, setose; disc confluent punctate, bearing sparse short erect hairs; clypeofrontal suture transverse, with a posteromedian node. Frons glabrous but punctate, sometimes with a vague median ridge. Ocular canthi with yellowish brown hairs; eyes very protuberant.

Pronotum transverse, sides rounded, angles not acute, marginal ridges continuous, disc with sparse punctures becoming denser and coarser laterally, with paired lateral pigmented impressions, median impunctate stripe, and scattered micropunctures. Scutellum punctate, prescutellar hairs yellow.

Elytra with epipleurae rather broadly membranous; disc smooth, shining, with distinct rows of small lightly impressed punctures.

Fore tibia (Fig. 62) with median tooth closer to distal than to proximal tooth but without a re-entrant angle, proximal tooth small and situated at mid point of tibia; fore tarsal claws faintly striated. Prosternal postcoxal process small but distinct; thoracic villosity pale yellow. Hind legs slender, tibia unicarinate, spurs separated by 2 ciliae.

Abdominal vestiture moderately abundant; pygidium slightly convex in profile, with median impunctate path from mid point of disc to propygidium, with rather sparse decumbent white or yellowish hairs, and submarginal erect pale brown hairs; lateral angles sometimes deeply impressed. Genitalia as in Figure 71.

♀. Unknown.

*Type locality*.—"Australia".

*Type location*.—ZM.

*Specimens examined*. Holotype ♂, "Australien. Coll. Sturm. Type 186" (ZM); ♂, "Dorrigo", ♂, "Bellingen" (NM).

## 7. PARASCHIZOGNATHUS PRASINICOLLIS Ohaus

Figs. 30, 48–50, 63, 72

*Paraschizognathus prasinicollis* Ohaus, 1904, Stettin. ent. Ztg. **65**: 128.

Olive green generally, with pronotum a somewhat brighter green; undersurface yellowish brown, suffused with green on abdomen. Length c.  $15\frac{1}{2}$  mm.

♂. Maxillary palp (Fig. 50) with sensorium of terminal segment superficial, occupying three-quarters of its length. Mandibles with molar area deeply pigmented and strongly ridged. Antenna (Fig. 49) 10-segmented, club equal in length to shaft. Mentum as in Figure 48.

Clypeus (Fig. 30) glabrous, subrectangular, disc flat in middle, but depressed on either side near slightly recurved lateral margins; anterior margin more abruptly recurved; sides only slightly convergent towards anterior margin, the anterior angles rounded off. Frons extensively flattened, the whole head with dense fine punctures; clypeofrontal suture pigmented at sides only.

Pronotum with sides somewhat angulately rounded, anterior angles normal, basal ridge obsolete across median third, disc with sparse fine punctures and a well-defined median impressed line. Scutellum finely punctate, with a faint median striole.

Elytra with epipleurae glabrous, narrowly membranous; disc with fine shallow punctures and with the brownish yellow pigmentation of epipleurae extending on to disc near apices and humeral calli.

Fore tibia (Fig. 63) with teeth equidistant, proximal tooth subobsolete, surface with large shallow setiferous punctures; claws striated. Thorax with abundant brownish yellow hairs, Hind legs slender, tibia bicarinate, spurs small and very unequal.

Abdomen densely clothed with fine hairs. Pygidium weakly convex, with shallow transverse rugulosity and very short pale yellow hairs on disc, these becoming a little longer and darker towards apex. Genitalia as in Figure 72.

♀. Unknown.

*Type locality*.—"Australia".

*Specimen examined*.—Holotype ♂ (lacking locality label) (ZM).

#### 8. *PARASCHIZOGNATHUS QUEENSLANDICUS*, sp. nov.

Figs. 31, 51, 64, 73

Head light brownish yellow with a faint green tinge, suffused with dark brown at edges. Pronotum and scutellum brownish green, with a reddish or yellowish tinge. Elytra usually darker than pronotum, a dull brownish yellow. Undersurface brownish to reddish yellow. Length  $13\frac{1}{2}$ –15 mm.

♂. Terminal segment of maxillary palp less than half length of antennal club, with superficial sensorium occupying three quarters of its length. Antenna 10-segmented, club slender, equal in length to shaft, longer than mid length of clypeus.

Clypeus (Fig. 31) with sides straight, convergent anteriorly, scarcely recurved, dilated briefly at abruptly recurved anterior margin; truncated face deep, setose; disc glabrous, confluent punctate. Clypeofrontal suture trisinate, pigmented only at sides. Frons flattened, with a vague median ridge, heavily punctate. Ocular canthi curved, bearing brownish yellow hairs. Eyes prominent.

Pronotum with anterior angles normal, anterior ridge usually continuous, basal ridge interrupted across rounded or weakly bilobed central portion, disc abundantly



punctate, with a distinct median impressed line and lateral pigmented patches. Scutellum punctate anteriorly.

Elytra with epipleurae bearing sparse hairs; disc frequently ridged across base near scutellum, calli poorly defined, punctures subobsolete, surface transversely wrinkled, very finely microreticulate.

Fore tibia (Fig. 64) with teeth equidistant, proximal tooth small, placed anterior to mid point of tibia, surface with large shallow punctures, claws strongly striated. Hind legs slender, tibia with 1 distinct carina, and with scattered ciliae proximally, spurs long and sharp, very unequal, separated by 2-3 ciliae. Thorax clothed with abundant brownish yellow hairs.

Pygidium with very fine sparse hairs, and longer erect hairs near apex, the latter rounded; disc only slightly compressed at sides, transversely rugulose. Genitalia as in Figure 73.

♀. Antennal club (Fig. 51) shorter than shaft, maxillary palp shorter than in ♂. Anterior truncated face of clypeus much shallower, bearing setae placed in a transverse groove, the disc shorter, more rounded, evenly recurved at margins, surface rugulose, clypeofrontal suture distinct across whole width. Pronotal punctation less dense. Epipleurae subobsolete on posterior half of elytra. Hind legs shorter, tibia bicarinate, spurs shorter and less acute, separated by 3 ciliae. Pygidium impressed in angles, more compressed at sides, apex broadly truncate.

*Type locality*.—Cooroy, S.Qld.

*Specimens examined*.—Holotype ♂, "Cooroy, S.Q."; allotype ♀ without locality label; paratype ♂, "Cooroy, nr. Gympie, Qld. Illidge"; 2 paratype ♂♂ without locality labels (QU); 2 paratype ♂♂ without locality labels (QM); paratype ♂, "Cooroy, Blackall Rgs. Qld., Oct. 1910. J. W. Mellor" (SAM).

## 9. PARASCHIZOGNATHUS BRUNNEUS, sp. nov.

Figs. 52, 66

Light tan dorsally, elytra a shade darker than head and pronotum, eyes marbled grey and black; fore tibia and clypeus darkened at edges. Length c. 14½ mm.

♂. Antenna 10-segmented, club longer than shaft. Maxillary palp rather short, sensorium of terminal segment superficial and occupying only proximal half. Mentum as in Figure 52.

Clypeus with sides rounded, slightly recurved, anterior margin more strongly so; disc glabrous, confluent punctate; clypeofrontal suture distinct, transverse; frons not flattened, coarsely punctate; ocular canthi curved, bearing reddish yellow hairs.

Pronotum with anterior angles normal, marginal ridges continuous, sides evenly rounded; disc sparsely punctate in middle, with a vague median line, heavily punctate at sides, and with a pair of lateral impressions. Scutellum with small scattered punctures.

Elytra with epipleurae setiferous almost to apices, membranous border conspicuous on posterior half; disc with punctures small but heavily impressed, calli poorly defined.

Fore tibia (Fig. 66) with teeth equidistant, claws striated. Thorax with abundant brownish yellow hairs. Hind legs slender, tibia bicarinate; spurs sharp, separated by 2 ciliae.

Abdomen sparsely setose on mid line; pygidium weakly convex in profile, subvertical, with inconspicuous short pale yellow decumbent hairs, and larger brownish yellow erect hairs along margins, apex rather narrowly truncate.

♀. Unknown.

*Type locality*.—Kincumber, N.S.W.

*Specimen examined*.—Holotype ♂, "Kincumber, N.S.W., Dec. '49, L. Mors" (CSIRO).

### Subtribe SCHIZOGNATHINA Ohaus

Schizognathina Ohaus, 1918, Col. Cat. Junk 20(66): 174.

#### KEY TO GENERA OF THE SUBTRIBE SCHIZOGNATHINA

1. Larger claws of middle and hind legs simple .....2  
Larger claws of middle and hind legs toothed .....14
- 2(1). Median process of labrum contiguous with distal margin of labium; mandibles incapable of contact at apices .....3  
Median process of labrum curved into mouth cavity and neither visible externally nor contiguous with distal margin of labium; mandibles capable of contact at apices....8
- 3(2). Labrum with lower margin rounded, not forming a median projection; ♂ fore tarsus with 1st and 2nd segments subequal in length; maxillary palp small .....4  
Labrum with lower margin produced to a point at middle; ♂ fore tarsus with 1st segment about twice length of 2nd; maxillary palp enlarged .....6
- 4(3). Labium with distal margin bilobed, or gently rounded, or with an obtuse median prominence; never with a distinct process .....5  
Labium with distal margin produced at middle into a conspicuous, flat, apically bidentate process (Fig. 97); galea (Fig. 95) strongly curved and brought to a single acute apical tooth .....3. *Exochogenys*, gen. nov.
- 5(4). Lateral margin of mandible curved upwards, and notched (Fig. 75); galea bearing numerous strong sharp teeth (Fig. 76); dorsal surface of body clothed with adpressed scales .....1. *Trioplognathus* Ohaus  
Lateral margin of mandible (e.g. Fig. 85) neither curved upwards nor notched; galea (e.g. Fig. 83) without distinct teeth, but with small denticles and articulated bristles; dorsal surface of body glabrous, or with erect hairs .....2. *Schizognathus* Fischer
- 6(3). Epipleurae narrowly membranous, disc of elytra punctate but the intervals not costate; ocular canthi very short, almost vertical; claws long and slender .....7  
Epipleurae non-membranous, disc of elytra coarsely punctate, wrinkled, the intervals strongly costate; ocular canthi transverse, of normal length; claws short and stout .....6. *Homotropus* Waterhouse
- 7(6). Pronotum clothed with long erect hairs; labial palp 2-segmented; ♂ eyes protuberant; both frons and clypeus compressed and elongate (Fig. 99), the former broader at apex than at base .....4. *Amblochilus* Blanchard  
Pronotum glabrous; labial palp 3-segmented; ♂ eyes of abnormal size but head not compressed .....5. *Pseudoschizognathus* Ohaus

- 8(2). Mentum dynastoid, highly convex in lateral profile, the apex curved upwards into mouth cavity; small species with elytra strongly punctate, and with large antennal club in ♂ ..... 9
- Mentum flat, or at most gently convex in profile, the apex visible without dissection ... 10
- 9(8). Elytra with intervals strongly costate; clypeal margins not strongly recurved ..... 7. *Mesystoechus* Waterhouse
- Elytra with intervals not costate; clypeal margins strongly recurved ... 8. *Chilopocha* Lea
- 10(8). Mandibles with apices abruptly and strongly bent upwards; sides of pronotum evenly rounded ..... 11
- Mandibles with apices more or less horizontal; sides of pronotum conspicuously angulate (Fig. 144) ..... 13. *Amblyterus* Macleay (*deuqueti*)
- 11(10). Labial and maxillary palps with terminal segments greatly enlarged and with very deeply impressed sensoria in ♂ (Fig. 124), that of maxilla as long as antennal club; clypeus strongly (Fig. 123) contracted anteriorly; epipleurae non-membranous ..... 9. *Dungoorus*, gen. nov.
- Labial and maxillary palps elongate, the terminal segments tapered and with sensoria not impressed; that of the maxilla shorter than antennal club; clypeus rounded or quadrangular, never constricted toward apex; epipleurae with a membranous border ..... 12
- 12(11). Antennae of similar size in both sexes, club always shorter than shaft; mouthparts concealed beneath clypeus; usually with fore tibia 2-dentate and body clothed with adpressed white scales ..... 10. *Mimadoretus* Arrow
- Antennae greatly enlarged and with club longer than shaft in ♂; mouthparts commonly produced beyond margin of clypeus; fore tibia 3-dentate, body without scales... 13
- 13(12). Fore tarsus short, stout, and with segments 1-4 together not or scarcely longer than segment 5 ..... 11. *Saulostomus* Waterhouse
- Fore tarsus slender, elongate, with segments 1-4 together much longer than segment 5 ..... 12. *Eosaulostomus* Carne
- 14(1). Small species (9-12 mm) with claws very finely toothed; maxillary palp with terminal segment slender; antennal club much larger in ♂ than in ♀ ..... 7. *Mesystoechus* Waterhouse
- Larger species (13-22 mm) with larger claws strongly toothed; maxillary palp with terminal segment often greatly enlarged, always with an impressed sensorium; antennal club of similar length in the two sexes ..... 13. *Amblyterus* Macleay (except *deuqueti*)

## 1. Genus TRIOPLOGNATHUS Ohaus

Figs. 74-76

*Trioplognathus* Ohaus, 1904, Stettin. ent. Ztg. 65: 68, 133.

Type species *Anoplognathus griseopilosus* Ohaus, 1901 (by monotypy).

This genus was erected by Ohaus to contain a species previously described by him as *Anoplognathus griseopilosus*. The present author (1957a) in discussing *A. antiquus* Arrow, suggested that the two species were probably synonymous, and that *antiquus* appeared to be correctly placed in *Anoplognathus*. This opinion was based on a study of the type pair of *antiquus*. Since then, the author has seen the type of *griseopilosus* and confirmed the synonymy. However, this latter specimen has the mouthparts dissected, and there seems little doubt that the mentum (Fig. 74) and



mandibles (Fig. 75) differ sufficiently from those of an *Anoplognathus* to justify Ohaus in having erected a separate genus for this species.

*Trioplognathus* differs from *Anoplognathus* in that the labium is not produced at its apex to form a hooked process entering the mouth cavity, and in the form of its mandibles. In labial structure it resembles *Schizognathus*, but the mandibles are unlike those of any other Australian ruteline.

## 1. *TRIOFLOGNATHUS* GRISEOPILOSUS (Ohaus)

Figs. 74–76

*Anoplognathus griseopilosus* Ohaus, 1901, Dtsch. ent. Z. **1901**: 130.

*Trioplognathus griseopilosus* Ohaus, 1904, Stettin. ent. Ztg. **65**: 134.

*Anoplognathus antiquus* Arrow, 1919, Ann. Mag. Nat. Hist. (9)**4**: 382. Carne, 1957, Aust. J. Zool. **5**: 139 (syn. nov.).

A redescription of this species has been given by the present author (Carne 1957a) and will not be repeated here. The species may be distinguished at once from all other schizognathines by its size (21–24 mm) and by the whole of its dorsal surface being clothed with small adpressed white scales; these arise singly from each puncture. The only ruteline with which it might be confused is *Anoplognathus velutinus* Boisd., but, in this species, groups of from 2 to 4 scales arise from each puncture, and there are many other structural differences.

*Type locality*.—Of *griseopilosus*, "Sydney, N.S.W."; of *antiquus*, "Richmond R., N.S.W.".

*Type locations*.—Of *griseopilosus*, ZM; of *antiquus*, BM.

*Specimens examined*.—♂, ♀ types *antiquus*, ♂ type *griseopilosus*.

## 2. Genus *SCHIZOGNATHUS* Fischer

Figs. 77–91

*Schizognathus* Fischer, 1823, Mem. Soc. Imp. Moscow **6**: 263. Burmeister, 1844, Handb.

Ent. **4**(1): 462; 1855, op. cit. **4**(2): 527. Ohaus, 1904, Stettin. ent. Ztg. **65**: 68, 135.

*Type species* *Schizognathus macleayi* Fischer, 1823 (by monotypy).

Two species referred to this genus (*prasinus* Boisd. and *nigripennis* Blanch.) were transferred to a new genus by Ohaus in 1904. The second of these species is not congeneric with the other species so placed by Ohaus, and is here removed to the genus *Exochogenys*, gen. nov. With the addition of one new species, *Schizognathus* may be recharacterized as follows:

Rather robust insects, 14–22 mm in length; reddish brown, brownish green, or brownish yellow in colour.

Labium with mentum (e.g. Fig. 84, 86, 87) rounded distally, or brought to a small median point, never forming a conspicuous process incurved into mouth cavity; labial palps thick, sickle-shaped. Maxilla (e.g. Fig. 83) with palp short, slender sensorium not impressed; galea short, without well-formed teeth, but with small denticles and articulated bristles. Mandibles (e.g. Fig. 85) strongly built, the scissorial area bidentate. Antenna 10-segmented, club rarely as long as, usually shorter than, shaft.

Clypeus usually strongly constricted before recurved anterior margin, the lateral ridges deflexed and in part not visible from above; less commonly with sides subparallel before dilation at anterior angles. Clypeofrontal suture usually distinct, trisinate, often with a distinct median node. Frons rather flattened, with an obscure median longitudinal ridge originating at mid point of clypeofrontal suture.

Pronotum with marginal ridges continuous, or almost so; basal margin slightly produced as a simple lobe over scutellum, anterior angles subacute or rarely subobtusate, sides evenly rounded or subangulate, disc with at least a trace of a median longitudinal impression.

Elytra with disc irregularly punctate; posterior two-thirds of epipleurae glabrous or with only minute setae, narrowly membranous near apices.

Fore tibia 3-dentate, the teeth equidistant or with median tooth closer to distal than to proximal tooth; tarsus with segment 5 equal in length to segments 1-4 together (except in *lucidus*). Prosternum forming a setose postcoxal process. Mesosternum forming a process only in *lucidus* and *mesosternalis*. Thorax bearing dense erect hairs. Hind legs strongly built, tibia bicarinate: spurs sharp, unequal.

Abdomen glabrous or with only sparse fine hairs across middle; pygidium finely punctate, more or less flat in profile, with short fine decumbent hairs on disc, and longer erect hairs near apex, the latter subtruncate.

♀. Clypeus short, trapezoidal, the anterior angles rounded. Fore tarsus slender, with segments 1 and 5 equal in length to each other and to segments 2-4 combined; the larger anterior claws distally toothed. Legs more robust.

#### KEY TO MALES OF THE GENUS SCHIZOGNATHUS

1. Mesosternal process extending to fore coxae. Length 17-18½ mm. N.Qld. .... 1. *mesosternalis* Ohaus  
 Mesosternal process not developed, or at most a blunt prominence not extending more than half way to fore coxae ..... 2
- 2(1). Clypeus (e.g. Fig. 77) strongly contracted before recurved anterior margin ..... 3  
 Clypeus rounded, or with sides subparallel in proximal two-thirds (e.g. Figs. 81, 82) .... 6
- 3(2). Antenna with club equal in length to shaft. Deep reddish brown species, 17-22 mm in length. Coastal N.S.W. and Vic. .... 2. *burmeisteri* Ohaus  
 Antenna with club shorter than shaft. Green or yellowish brown species ..... 4
- 4(3). Clypeus bearing abundant erect hairs; pronotum with distinct median impressed line; pygidium evenly and densely clothed with short hairs ..... 5  
 Clypeus almost glabrous; pronotum finely micropunctate, with only a vague suggestion of a median line; pygidium almost glabrous in middle; elytra concolorous. Greenish brown species, 14-20 mm in length. N.Qld. .... 5. *viridiaeneus* Ohaus
- 5(4). Anterior clypeal angles produced (Fig. 79), the anterior margin concave in profile; pronotum smooth and shining in middle; elytra with yellowish band parallel to epipleurae. Large greenish brown species 16-20 mm in length. S. Qld. and northern N.S.W. coastal and subcoastal districts ..... 3. *compressicornis* Ohaus  
 Anterior clypeal angles not produced, anterior margin straight; pronotum finely rugulose except on median third; elytra concolorous. Smaller species, c. 16 mm in length. Western N.S.W. .... 4. *rugulosus*, sp. nov.

- 6(2). Mesosternal process blunt, extending barely half way to fore coxae; fore tarsus with 1st segment elongate. Clypeus as in Figure 81. Length 17–20 mm. S. Qld. ....  
 .....6. *lucidus* Ohaus
- Mesosternal process not developed; fore tarsus with 1st segment not longer than 2nd; clypeus as in Figure 82. Length 18–21 mm. N.S.W., Qld. ....7. *macleayi* Fischer

### 1. SCHIZOGNATHUS MESOSTERNALIS Ohaus

*Schizognathus mesosternalis* Ohaus, 1912, Ent. Rdsch. **29**: 113.

Light yellowish or greenish brown species, with white thoracic and coxal vestiture; with a well-developed mesosternal process.

♂. Length 17–18½ mm. Antennal club shorter than shaft.

Clypeus elongate, sides concave in outline, strongly dilated at recurved anterior margin, lateral ridges deflexed from dorsal view; anterior truncated face very deep, sparsely setose; disc markedly concave, concentrically rugulose, bearing dense short erect hairs. Clypeofrontal suture trisinate. Frons depressed behind suture, especially at sides; surface with irregular confluent punctures and scattered micropunctures. Ocular canthi long, slender, bearing white hairs. Eyes large and dark.

Pronotum with sides strongly rounder, widest at two-thirds distance from basal margin; anterior angles normal, basal angles obtuse; disc with fine shallow punctures and very numerous micropunctures, with a subobsolete median impunctate stripe. Scutellum with similar punctation and with trace of a median stria.

Elytra compressed at sides, subapical calli obscure, disc with small dark punctures forming distinct striae, the intervals smooth; epipleurae glabrous, thickened over hind part of mesocoxae; obsolete near apices where broadly membranous.

Fore tibia broad, clothed with white hairs, surface micropunctate, median tooth closer to proximal than to distal tooth. Mesosternal process slender, sharply pointed, extending to mid point of fore coxae, depressed but not recurved, setose almost to apex.

Abdomen with sparse white decumbent hairs and a single row of white erect hairs on each sternite. Pygidium subvertical, moderately convex in profile, strongly compressed at sides, surface densely micropunctate between setiferous punctures.

♀. Length 16–21 mm.

Clypeus with disc glabrous, confluent punctate; sides gently curved, convergent, apically subtruncate, margins recurved; clypeofrontal suture transverse or posteriorly angulate; ocular canthi bearing brownish yellow hairs.

Pronotum with distinct impunctate median line, this containing numerous micropunctures especially near anterior margin; disc with punctures becoming distorted and confluent at sides, variably micropunctate.

Fore tibia with vestiture less abundant than in ♂ and of a pale yellowish brown, teeth equidistant, surface not micropunctate. Hind tibial spurs very unequal. Mesosternal process extending to hind margin of fore coxae, sometimes glabrous. Epipleurae thickened over junction of meso- and metacoxae.



This species was described by Ohaus from a female; the above is the first description of a male.

*Type locality*.—Herberton, N. Qld.

*Type location*.—ZM.

*Specimens examined*.—♂, "Lake Barrine, Atherton T'land, N.Q., 3 July '34, E. le G. Troughton & H. O. Fletcher" (designated as a plesioallotype by the present author) (AM); 2♂♂, "Gordonvale, W. C. Dormer" (QM); ♀, "Millaa Millaa, Q., F. H. Taylor, 2,689 ft." (CSIRO); ♀, "Lake Barrine", 3.2.35, A. Burns" (FEW); ♀, "Barine, 9.1.30" (also labelled "*S. lucidus*, Brisbane") (QU); type ♀, "N. Queensl. Herberton" (ZM).

## 2. SCHIZOGNATHUS BURMEISTERI Ohaus

Figs. 77, 78, 83–85, 88

*Schizognathus burmeisteri* Ohaus, 1904, Stettin. ent. Ztg. **65**: 138. Lea, 1919, Trans. Roy. Soc. S. Aust. **43**: 244, pl. 27, fig. 73.

Concolorous reddish brown species, with a faint green sheen. Thoracic vestiture brownish yellow.

♂. Length 17–22 mm. Antennal club subequal in length to shaft; eyes prominent.

Clypeus (Fig. 77) strongly contracted at middle, anterior margin recurved, the edge concave in profile; anterior truncated face very deep, setose, excavated in middle; lateral margins with ridges depressed below dorsal view; abruptly angulate near ocular canthi; disc setose, with erect reddish brown hairs, finely and closely rugulose, and with a pink tinge. Vertex with discrete punctures. Canthi with reddish brown hairs.

Pronotum with sides parallel at base, angulate towards subacute anterior angles, bearing sparse dorsal setae near the latter; disc smooth, shining, with an impunctate median line; punctures fine, rather dense, larger and subconfluent at sides; with a pair of irregular lateral impressions on surface. Scutellum finely punctate, especially near margins.

Elytra with humeral angles clothed with reddish brown hairs, epipleurae well defined, almost glabrous, minutely serrate and narrowly membranous near apices; both pairs of calli distinct; disc with fine punctures forming distinct striae, surface micropunctate.

Fore tibia with teeth strongly developed, equidistant, abundantly clothed. Postcoxal prosternal process bearing a tuft of light yellow hairs.

Abdomen with abundant yellow hairs across sternites 1 and 2, these sparse across middle of remaining sternites. Pygidium weakly convex in profile, with very short decumbent white hairs on disc, angles weakly impressed, punctures rather distorted and interspersed with micropunctures. Genitalia as in Figure 88.

♀. Length 17½–24 mm. Antennal club shorter than shaft, maxillary palp smaller; clypeus (Fig. 78) rounded, evenly recurved, clypeofrontal suture angulate in middle.

Pronotum more convex, with additional paired impressions on disc. Epipleurae obsolete except at bases of elytra. Fore tibial teeth less acute but more deeply separated. Pygidium slightly contracted at sides.

*Type locality*.—Given by Ohaus (1904) as "Queensland, Cairns; N.S.W., Lambton". The species has never otherwise been recorded from Queensland, and the specimen was probably incorrectly labelled; Lambton is well within the known range of the species.

*Type location*.—ZM.

*Specimens examined*.—38 (CSIRO; FEW; NM; QU; SAM).

*Distribution*.—NEW SOUTH WALES: Canterbury, Lambton, Mt. Irvine, National Park, Sydney. VICTORIA: Beaconsfield, Croydon, Gippsland, Mallacoota Inlet, Newborough, Nunawading, Orbost.

### 3. SCHIZOGNATHUS COMPRESSICORNIS Ohaus

Figs. 79, 89

*Schizognathus compressicornis* Ohaus, 1898, Stettin. ent. Ztg. **59**: 38; 1904, op. cit. **65**: 141.

Dull brownish green species, ♂ elytra usually with a lighter yellowish band parallel to epipleurae; thoracic and coxal vestiture white. This species is very closely related to *viridiaeneus* Ohaus and the latter name is frequently misapplied to it in Australian collections.

♂. Length 16–21 mm. Clypeus (Fig. 79) similar to that of *viridiaeneus* but with lateral ridges not visible from above, anterior angles strongly produced, and anterior margin markedly concave, apical truncated face glabrous, slightly impressed; disc, ocular margins of frons, and ocular canthi bearing erect white hairs. Clypeo-frontal suture bisinuate, slightly elevated, more distinct than in *viridiaeneus*.

Pronotum with basal angles obtusely rounded, anterior angles subacute; disc with median impressed line, with sparse fine punctures and micropunctures near lateral margins, and with complex paired lateral impressions.

Elytra densely micropunctate, more finely so than in *viridiaeneus*; epipleurae with white humeral bristles, sparsely setose along whole length. Fore tibia micropunctate, with a red tinge, with median tooth closer to distal than to proximal tooth.

Pygidium with conspicuous decumbent white hairs; lateral angles not impressed. Genitalia as in Figure 89.

♀. Length 19–21 mm. Dorsal surface lacking micropunctuation of ♂; median pronotal line obsolete; elytra with lateral lightly pigmented band not developed. Hind tibia differing in structure, much more expanded distally, the spurs shorter.

*Type locality*.—Richmond R., N.S.W. One cotype labelled "Qld."

*Type location*.—ZM.

*Specimens examined*.—♂ and ♀ cotypes plus 47 (AM; BSES; CSIRO; FEW; CFD; NM; QDAS; QU; ZM).

*Distribution*.—QUEENSLAND: Killarney, McPherson Range, Mt. Gravatt, Mt. Lamington, Mt. Tambourine, National Park. NEW SOUTH WALES: Acacia Ck., Bellingen, Dorrigo, Lismore, Orara, Richmond R., Tamworth, Tooloom, Tweed R., Uki.

4. *SCHIZOGNATHUS RUGULOSUS*, sp. nov.

Uniform yellowish brown species, c. 16 mm in length. Thoracic and coxal vestiture white.

♂. Antenna with club slightly shorter than shaft.

Clypeus with sides concave in outline, lateral ridges deflexed, barely visible from above; anterior margin recurved, the edge straight; truncated face moderately deep, setose; disc concave, finely and confluent punctate, bearing erect yellow hairs; clypeofrontal suture posteriorly angulate; anterior part of frons and ocular canthi setose.

Pronotum with sides slightly angulate, anterior angles normal; disc with rather coarse shallow punctures and irregular zones of fine rugulosity extending over lateral thirds, and with a distinct median impressed line.

Elytra coarsely rugulose, the striae obliterated; epipleurae narrow, continuous, narrowly membranous.

Fore tibia with median tooth closer to distal than to proximal tooth. Hind legs rather slender.

Abdomen with white hairs across all sternites except last; pygidium weakly convex in profile, densely clothed with short white decumbent hairs, not compressed at sides.

♀. Unknown.

*Type locality*.—Albury, N.S.W.

*Type location*.—CSIRO.

*Specimen examined*.—Holotype ♂, "Albury, 21.12.49, R. A. Freer".

The form of its clypeus associates this species with *viridiaeneus* from which it differs in its smaller size, rugulose dorsal surface, and well-defined median pronotal furrow.

5. *SCHIZOGNATHUS VIRIDIAENEUS* Ohaus

Figs. 80, 87, 90

*Schizognathus viridiaeneus* Ohaus, 1904, Stettin. ent. Ztg. 65: 140.

Dull brownish green species, with dense yellow thoracic and coxal vestiture.

♂. Length 14–20 mm. Antennal club shorter than shaft.

Clypeus (Fig. 80) with sides contracted anteriorly, then dilated at recurved anterior margin, the latter weakly concave in profile; truncated face deep, sparsely setose; lateral ridges visible from above, disc very finely and closely punctate, somewhat rugulose, with a faint pink sheen. Clypeofrontal suture transverse, subobsolete across middle. Frons depressed, micropunctate, green. Ocular canthi bearing white setae.

Pronotum with median impunctate line subobsolete, with sparse fine punctures interspersed among very numerous micropunctures lateral margins rounded, anterior angles subacute. Scutellum micropunctate, especially in middle.

Elytra with disc shallowly punctate, surface wrinkled, densely micropunctate; epipleurae poorly defined, glabrous except near humeral angles.



Fore tibia with teeth only shallowly separated, median tooth closer to distal than to the very small proximal tooth.

Pygidium vertical, slightly convex in profile, clothed with fine short white hairs, lateral angles not or only slightly impressed. Abdomen with sparse white hairs across all sternites. Whole under surface, including legs, micropunctate. Genitalia as in Figure 90.

♀. Unknown. Lea (1919) described a ♀ he identified as *viridiaeneus*, but examination of the specimens he studied shows them to be examples of *compressicornis*.

*Type locality*.—Cape York, Qld.

*Type location*.—ZM.

*Specimens examined*.—♂ cotype plus 11 (CSIRO; NM; ZM).

*Distribution*.—QUEENSLAND: Cooktown, Cape York.

## 6. SCHIZOGNATHUS LUCIDUS Ohaus

Figs. 81, 86, 91

*Schizognathus lucidus* Ohaus, 1904, Stettin. ent. Ztg. 65: 142.

This species has characters, especially of the mesosternum, that associate it with *Anoplognathus*, and together with *mesosternalis*, it provides a link between the two genera.

Reddish brown species, with white thoracic and coxal vestiture.

♂. Length 16–20 mm. Antennal club shorter than shaft.

Clypeus (Fig. 81) with anterior margin broadly recurved, sides bisinuate, apical truncated face moderately deep, setose; disc glabrous, confluent punctate; ocular canthi with reddish brown setae.

Pronotum convex, with only a trace of a median line, marginal ridges continuous, sides subangulate, anterior angles subacute; disc shining, micropunctate near lateral margins.

Elytra heavily punctate, wrinkled, striae barely discernible epipleurae setose only at humeral angles, their apical portion narrowly membranous.

Fore tibia with teeth equidistant; tarsus with segment 5 as long as segments 1–4 combined. Mesosternum produced between coxae, forming an anoplognathoid process extending half way to fore coxae.

Pygidium flat, sloping, with micropunctures and sparse punctures, almost glabrous except for long brownish yellow hairs at apex, compressed at sides but not in lateral angles. Abdomen almost glabrous across middle. Genitalia as in Figure 91.

♀. Length 20–22½ mm. The author has not seen specimens of this sex, and the following notes are taken from a translation of Ohaus (1904):

“Clypeus trapezoidal with slightly recurved anterior margin, edged with black, surface level, densely rugulose; clypeofrontal suture less angulate in middle, frons densely and coarsely punctate . . . Pronotum with finer and sparser punctation than in ♂ . . . Elytra darker and more glossy . . . Pygidium with apex narrower and slightly produced . . . Fore tarsi more elongate, the larger claws finely toothed.”

*Type locality*.—Cape York, Qld.

*Type location*.—ZM.

*Specimens examined*.—13 (CSIRO; QDAS; QU; SAM).

*Distribution*.—QUEENSLAND: Brisbane, Cape York, Glasshouse Mountains, Stanthorpe.  
NEW SOUTH WALES: Kincumber, Tooloom.

### 7. SCHIZOGNATHUS MACLEAYI Fischer

Fig. 82

*Schizognathus macleayi* Fischer, 1823, Mem. Soc. Imp. Moscow **6**: 263, pl. 22, fig. 8.

Boisduval, 1835, Voy. Astrolabe, Col. **2**: 184. Burmeister, 1844, Handb. Ent. **4**(1): 462. Ohaus, 1904, Stettin. ent. Ztg. **65**: 138.

Reddish brown species with slight green sheen on head and pronotum: thoracic and coxal vestiture white.

♂. Length 18–23 mm. Antennae with club shorter than shaft.

Clypeus (Fig. 82) with sides subparallel, dilated at strongly recurved anterior margin, the latter evenly rounded in profile; anterior truncated face deep, setose not excavated; disc rugulose, sparsely setose; clypeofrontal suture obscure, more or less straight; frons confluent punctate, setose on ocular margins, slightly depressed in middle and sometimes divided by a ridge derived from mid point of suture.

Pronotum with sides rounded, all angles obtuse; disc with fine punctures and dense micropunctures, with a distinct median line. Scutellum micropunctate.

Elytra with surface irregular, micropunctate, striae indistinct: epipleurae with white humeral hairs.

Fore tibia with teeth either equidistant, or with median closer to distal than to proximal tooth; tarsus short. Hind tibia coarsely sculptured.

Propygidium with caudal fringe of short fine setae; pygidium flat, densely micropunctate, bearing white hairs on disc; sides slightly compressed, lateral angles not indented. Abdomen with sparse white hairs across mid line.

♀. The author has not seen an example of this sex, and although Ohaus (1904) implied that he had seen specimens, he did not describe how it differs from the ♂.

*Type locality*.—Unknown.

*Type location*.—Believed to be in Moscow.

*Specimens examined*.—11 ♂♂ (AM; CSIRO; QDAS).

*Distribution*.—QUEENSLAND: Pine R. NEW SOUTH WALES: Bundanoon (1250 ft, near Cutler's Pass, Barrington Tops region), Manning R.

### 3. Genus EXOCHOGENYS, gen. nov.

Figs. 92–97

Type species *Schizognathus nigripennis* Blanchard, 1850.

This species was discussed by Ohaus (1904) who transferred it to his genus *Paraschizognathus* on the grounds that it possessed a labium characteristic of that genus, i.e. with the apex produced and curved into the mouth cavity. The species is very unlike any other *Paraschizognathus* and makes a satisfactory characterization of that genus almost impossible. Examination of a number of specimens of *nigripennis*

has shown that the labial process is not recurved but is quite flat, and in the same plane as the labium as a whole. Moreover, it is of a form quite unlike that of any other Australian ruteline. This character, together with others that isolate the species, suggest that it is best regarded as generically distinct.

Labium with apex produced as a flat, apically bidentate lamina (Fig. 97); maxilla with galea produced to a single slender tooth (Fig. 95). Labrum transverse.

♂. Antenna 10-segmented, club subequal in length to shaft.

Clypeus transverse, anterior margin recurved; clypeofrontal suture obscure.

Pronotum with marginal ridges continuous, disc punctate and with a faint impunctate median stripe at least on anterior half.

Epipleurae narrow, hirsute, narrowly membranous.

Fore tibia 3-dentate; fore tarsus short, with segment 5 as long as segments 1-4 together. Hind legs slender.

Pygidium weakly convex in profile, clothed with short white hairs, the apex rounded.

♀. Clypeus shorter, more transverse. Fore tarsus with 1st segment as long as 5th; larger anterior claws distally toothed. Hind legs slightly stouter.

#### 1. *EXOCHOGENYS NIGRIPENNIS* (Blanchard), comb. nov.

Figs. 92-97

*Schizognathus nigripennis* Blanchard, 1850, Cat. Coll. Ent. Col. p. 224.

*Paraschizognathus nigripennis* Ohaus, 1904, Stettin. ent. Ztg. 65: 127.

Black species, or with elytra reddish black; undersurface dark reddish brown suffused with black at margins; pygidium with a reddish brown zone parallel to propygidium. Thoracic and coxal vestiture greyish yellow. Length 12-16 mm.

♂. Labial palp short, cylindrical, slightly curved. Maxillary palp (Fig. 95) small, terminal segment with dorsal sensorium occupying three-quarters of its length.

Clypeus (Fig. 94) with sides convex in outline, anterior margin indented in middle and recurved; anterior truncated face smooth, almost glabrous; surface of head with discrete setiferous punctures and irregular non-setiferous punctures and micropunctures, the hairs brown and erect. Ocular canthi with abundant long brown hairs.

Pronotum widest at basal angles, or with sides parallel in basal half; anterior angles normal; disc with dense large punctures, and two lateral impressed areas. Scutellum punctate except on margins, overlaid by dense yellow prescutellar hairs.

Elytra with deeply impressed punctures forming distinct striae, surface wrinkled at sides; epipleurae with setae extending on to disc, especially near calli.

Fore tibial teeth sharp (Fig. 96), median and proximal teeth separated by a re-entrant angle. Hind tibia 1-2 carinate, the ciliae long and interspersed with fine brown hairs.

Abdomen with 2 rows of fine hairs across each sternite, last sternite weakly excised on hind margin. Pygidium subvertical, discal hairs patterned towards mid



line, and with larger erect yellowish hairs on posterior half of disc. Genitalia as in Figure 92.

♀. Palps and antenna smaller than in ♂. Clypeus with sides slightly convergent anteriorly; anterior margin scarcely indentate. Pronotum with anterior angles bearing scattered dorsal setae. Fore tibia (Fig. 93) with intermediate tooth closer to proximal than to apical tooth. Pygidium less vertical.

*Type locality*.—"Nouvelle Hollande orientale".

*Type location*.—MDN.

*Specimens examined*.—11 (AM; CSIRO; NM; SAM).

*Distribution*.—NEW SOUTH WALES: Blue Mountains, 6 miles N.E. of Pigeonhouse Range, Nerriga, Sydney. VICTORIA and QUEENSLAND: No precise localities.

#### 4. Genus AMBLOCHILUS Blanchard

Figs. 98–100

*Amblochilus* Blanchard, 1850, Cat. Coll. Ent. Col. p. 255. Burmeister, 1855, Handb. Ent. 4(2): 528. Lacordaire, 1856, Gen. Col. 3: 378. Ohaus, 1904, Stettin. ent. Ztg. 65: 68, 151.

Type species *Amblochilus bicolor* Blanchard, 1850 (by monotypy).

♂. Labium flat, apex rounded or truncate, not produced; labial palp 2-segmented, terminal segment elongate, with conspicuous dorsal sensorium. Maxilla with galea small, weakly denticulate at apex; maxillary palp elongate, terminal segment as long as preceding segments together, equal in length to antennal club, with deeply impressed elongate sensorium. Labrum with an anteroventral process. Mandibles concealed beneath clypeus, weak, lacking a distinct apical tooth, molar area without ridges. Antenna 9-segmented, club much shorter than shaft.

Clypeus elongate, sides convex in outline, angles rounded, anterior margin recurved and wider than clypeofrontal suture; the latter obscure, somewhat posteriorly arcuate. Ocular canthi short, triangular, subvertical. Eyes very large. Frons narrow, elongate. Whole head with dense fine setiferous punctures.

Pronotum with anterior angles obtuse, marginal ridges continuous, basal margin medianly lobed; disc punctate and bearing erect hairs.

Elytra with epipleurae setose, narrowly membranous.

Fore tibia 3-dentate, tarsus slender, segments 2–3 together as long as segment 1; segment 5 with a conspicuous ventral projection; claws long, curved, subequal. Prosternal process small, concealed by dense thoracic hairs. Mesosternum not forming a process. Hind legs slender, corbels narrow.

Abdomen abundantly clothed with erect hairs.

♀. Palps smaller, sensoria of terminal segments more superficial. Anterior clypeal margin not wider than clypeofrontal suture. Eyes smaller, less protuberant. Pronotum more transverse, anterior angles very obtuse. Fore tibial teeth more deeply separated but proximal tooth relatively weaker; fore tarsus with segments 2–4 together equal in length to segment 1, segment 5 with ventral projection reduced. Hind tibial spurs very short, bluntly rounded, those of middle legs sharp and elongate.

1. *AMBLOCHILUS BICOLOR* Blanchard

Figs. 98-100

*Amblochilus bicolor* Blanchard, 1850, Cat. Coll. Ent. Col. p. 255. Ohaus, 1898, Stettin. ent. Ztg. **59**: 39; 1904, op. cit. **65**: 152.

Small bicolorous species: head pronotum, and, scutellum green; elytra dark straw; undersurface and pygidium reddish black; femora (partly) and tibiae straw. Length 11-15 mm.

♂. Mentum bearing long erect greyish yellow hairs; labial palp with terminal segment short and cylindrical. Maxillary palp with sensorium of terminal segment incised, placed either dorsally or laterally. Labrum setose, almost concealed by very deep truncated face of clypeus. Eyes greatly enlarged, canthi directed anteroventrally, almost invisible from above, bearing light brown hairs.

Clypeus (Fig. 99) with distinct anterior angles; sides not recurved but true margin deflexed from dorsal view; disc confluent punctate, with long grey hairs. Frons elongate, dilated at vertex, surface as that of clypeus.

Pronotum transverse, sides parallel in basal two-thirds; disc with dense, rather heavily impressed punctures except on narrow median impunctate stripe, the surface irregularly clothed with white hairs. Scutellum with sparse punctures near apex, microreticulate.

Elytral disc strongly compressed below and beside humeral calli, subapical calli obsolete, epipleurae distinct almost to apices and bearing white hairs and a narrow membranous border.

Thoracic vestiture abundant, long, and white. Hind legs slender, tibia 1- or 2-carinate, spurs unequal, more or less blunt; tarsus short.

Abdomen with hairs across mid line. Pygidium vertical, weakly convex in profile, apex slightly truncate, disc microreticulate, with shallow transversely distorted punctures and long erect white hairs.

♀. Head as in Figure 98; truncated face of clypeus less deep; sides straight, with true margins visible from above; disc rather humped; frons setose on ocular margins only. Pronotum with sides diverging from basal angles to point of maximum width, ridges coarser, disc more strongly convex. Fore tarsus shorter, and claws smaller than in ♂. Hind legs stouter, spurs very short and blunt; hind tarsus as in Figure 100. Pygidium usually less convex in profile, with sparse yellowish hairs.

*Type locality*.—"Nouvelle Hollande".

*Type location*.—MDN.

*Specimens examined*.—13 ♂♂, 5 ♀♀ (MACL; NM; QDAS; QM; QU; SAM).

*Distribution*.—QUEENSLAND: Brisbane, National Park, Sunnybank, Toowoomba, Wyreema.

5. Genus *PSEUDOSCHIZOGNATHUS* Ohaus

Figs. 101-109

*Pseudoschizognathus* Ohaus, 1904, Stettin. ent. Ztg. **65**: 68, 145; 1913, Dtsch. ent. Z. **1913**: 333.

Type species *Pseudoschizognathus schönfeldti* Ohaus, 1904 (here selected).

♂. Labium (Fig. 102) flat, apex bilobed or briefly acuminate, not curved into mouth cavity. Labrum with small pigmented anteroventral process. Terminal segment of labial palp large, lanceolate, with deeply impressed sensorium; that of maxillary palp as long as remaining segments together, equal in length to antennal club. Antenna 10- or 9-segmented, club shorter than shaft.

Clypeus quadrangular, sides convex in outline, only anterior margin recurved; the latter nearly or quite as wide as clypeofrontal suture. Suture transverse, either straight or with a slight node in middle. Head bearing erect hairs.

Pronotum glabrous, punctate, with continuous marginal ridges and obtuse anterior angles.

Fore tibia 3-dentate, with teeth equidistant or with median tooth closer to proximal than to distal tooth; tarsus with segments 2-3 together as long as segment 1; claws long and slender. Thorax and coxae with erect white or greyish yellow hairs. Hind tibia with corbel very narrow; spurs short, separated by 1 or 2 ciliae.

Elytra with epipleurae narrowly membranous, setose.

♀. Clypeus narrowed anteriorly, angles rounded; head more closely punctate than in ♂, and palps smaller. Fore tarsus very slender, with segments 2-4 together as long as segment 1; claws of fore legs simple, rarely with larger claw finely toothed at apex. Hind tibial spurs much shorter, bluntly rounded, separated by 3-4 ciliae.

#### KEY TO SPECIES OF THE GENUS PSEUDOSCHIZOGNATHUS

1. Sides of clypeus depressed just before anterior angles; fore tibial teeth evenly spaced; 5th tarsal segment without a ventral process; concolorous reddish brown species. Qld.  
..... 1. *variicollis* Ohaus
- Sides of clypeus not depressed before anterior angles; fore tibial teeth unevenly spaced; 5th tarsal segment with a conspicuous ventral projection; elytra with margins much darker than disc. .... 2
- 2(1). Frons and vertex pale straw coloured; fore tibial teeth (Fig. 108) placed almost at right angles to major axis; pronotum with sides parallel in basal half. Vic., N.S.W. ....  
..... 2. *lajoyi* Ohaus
- Frons pale, vertex darkly pigmented; fore tibial teeth placed at much less than a right angle to axis; pronotum with sides contracted just anterior to basal angles. Qld., W.A.(?) ..... 3. *schoenfeldti* Ohaus

#### 1. PSEUDOSCHIZOGNATHUS VARIICOLLIS Ohaus

Figs. 101-105

*Pseudoschizognathus variicollis* Ohaus, 1904, Stettin. ent. Ztg. **65**: 146; 1913, Dtsch. ent. Z. **1913**: 333.

This species is rather distantly related to the other two members of this genus, and further collecting and study may result in it being removed to a separate genus more closely allied to *Schizognathus*.

Dorsally a uniform reddish brown; undersurface brownish yellow, darkened at sides. Length 14-16 mm.

♂. Labrum broad, with long hairs, apex shallowly acuminate. Mandibles (Fig. 102) apically bidentate, molar area deeply pigmented, but with ridges sub-



obsolete. Galea bearing two small spinules ventrally, with fine setae dorsally. Antenna (Fig. 104) 9-segmented.

Clypeus (Fig. 105) with short setose truncated face, rounded in outline but with sides depressed before anterior angles (reminiscent of *S. lucidus*); disc depressed, with dense deeply impressed punctures bearing sparse erect yellowish brown hairs at sides and on ocular canthi. Clypeofrontal suture with a slight median node; frons with sparse hairs on ocular margins.

Pronotum with sides evenly rounded; disc glabrous, with abundant strong punctures, these distorted and confluent at sides; with a distinct, more or less impunctate, median furrow. Scutellum punctate; prescutellar hairs golden.

Elytra with disc distinctly punctate, surface somewhat wrinkled, shining; epipleurae non-membranous, serrate, bearing short lateral hairs.

Fore tibia (Fig. 103) broad, tridentate, the teeth shallow, equidistant. Thoracic and coxal villosity brownish yellow. Hind legs moderately stout, femur with long pale hairs; tibia bicarinate; spurs unequal, separated by a single cilia.

Abdomen with erect hairs across all sternites. Pygidium weakly convex in profile, with hairs only on and near apex, remainder of disc microreticulate, and with small shallow irregular punctures; apical ridge with dense fringe of hairs. Genitalia as in Figure 101.

♀. Unknown.

*Type locality*.—Cape York, Qld.

*Type location*.—ZM.

*Specimens examined*.—♂ cotype (ZM); ♂, "Qld." (NM); 2 ♂♂, "Qld." (SAM).

## 2. PSEUDOSCHIZOGNATHUS LAJOYI Ohaus

Figs. 106–109

*Pseudoschizognathus lajoyi* Ohaus, 1913, Dtsch. ent. Z. **1913**: 334, 336.

Head, undersurface, and legs pale yellowish brown, the margins darkened; pronotum irregularly blotched with dark brown, and with a weak green sheen; margins of elytra brownish black, the disc yellowish brown. Length 14–16 mm.

♂. Terminal segments of both labial and maxillary palps with very large deeply impressed sensoria. Antenna 10- or 9-segmented, the segmentation rather indistinct near attachment to club.

Clypeus (Fig. 107) with very deep glabrous truncated face; narrowest at clypeofrontal suture, anterior margin gently rounded; disc with almost confluent punctures bearing erect pale golden hairs. Clypeofrontal suture with a posteriorly directed median node, this sometimes extended as a median longitudinal ridge on frons. Frons rugulose, clothed on ocular margins and very sparsely so on disc.

Pronotum with sides parallel in proximal half, then rounded to anterior angles; the latter with a few dorsal hairs; disc with a narrow impunctate median line, elsewhere with dense, strongly impressed punctures, lateral regions with punctures larger and intermixed with micropunctures. Scutellum punctate; prescutellar hairs white.

Elytra with small shallow irregular punctures, these not forming distinct striae, surface weakly wrinkled, shining; calli subobsolete, basal margin ridged; epipleurae obsolete before apices, with dark brown lateral hairs.

Fore tibia (Fig. 108) stout, the teeth almost at right angles to major axis; 5th tarsal segment with a strong ventral projection. Hind legs rather slender, femur glabrous, tibia somewhat flattened, carinae indistinct, spurs sharp, unequal, separated by a single cilia. Thoracic and coxal vestiture white.

Abdomen with sparse long white hairs at sides, glabrous across middle. Pygidium subvertical, moderately convex in profile, impressed in angles, apex truncate and with ridge slightly broadened, disc with numerous erect pale hairs. Genitalia as in Figure 106.

♀. Palps smaller, sensoria less deeply impressed. Clypeal face relatively shallow, sides straight and recurved at margins. Clypeofrontal suture posteriorly angulate, the whole head (Fig. 109) rugulose. Pronotum more convex, anterior angles acute and with more numerous dorsal hairs. Fore tibial teeth more deeply separated, but with proximal tooth relatively smaller; 5th tarsal segment with ventral projection less evident. Hind tibia with corbel setose, spurs very short, blunt, equal in length, separated by 3–4 ciliae. Pygidium almost glabrous, deeply impressed in angles.

*Type locality*.—Mt. Macedon, Vic.

*Type location*.—ZM.

*Specimens examined*.—6 ♂♂, 2 ♀♀ (FEW; NM; QM; SAM).

*Distribution*.—VICTORIA: Bulla, Colac, Evansford, Mt. Macedon. NEW SOUTH WALES: Clarence R.

A ♂ specimen from Loutit Bay, Vic. (NM), dubiously referred to this species, differs in having the legs and abdomen densely clothed with white hairs, the sides of the pronotum less curved, the anterior pronotal angles distinctly produced and acute, and the lateral pygidial angles very deeply indented.

### 3. *PSEUDOSCHIZOGNATHUS SCHOENFELDTI* Ohaus

*Pseudoschizognathus schoenfeldti* Ohaus, 1904, Stettin. ent. Ztg. **65**: 147; 1913, Dtsch. ent. Z. **1913**: 334.

*Pseudoschizognathus occidentalis* Ohaus, 1913, Dtsch. ent. Z. **1913**: 334 (syn. nov.).

When describing *schoenfeldti*, Ohaus gave the distribution of this species as Queensland and Western Australia. He subsequently designated the two males from the latter State as types of a new species *occidentalis*, which he separated on minor characters. The latter have been found to vary within series of *schoenfeldti* from Queensland to an extent that overlaps the distinctions he drew. Examination of the cotype of *occidentalis* has convinced the present author that it cannot be regarded as distinct; indeed, the specimen could be a mislabelled example from a Queensland locality. The female has not been described previously, and a specimen in the South Australian Museum has been designated as a plesioallotype.

Closely related to *lajoyi*, differing in having a more distinct pronotal colour pattern: the vertex darkened, the pronotum deep brownish black except on 2 postero-lateral regions which are light yellowish brown; scutellum wholly dark. Length 12–15 mm.

♂. Terminal segments of labial and maxillary palps with sensoria slit-like, not broadly open as in *lajoyi*. Antenna distinctly 10-segmented.

Clypeus with truncated face bearing sparse hairs, sides scarcely diverging before anterior angles, anterior margin more strongly recurved than in *lajoyi*; ocular canthi bearing pale yellow hairs.

Pronotum with sides slightly contracted just anterior to basal angles; disc with median line not impressed. Both pronotum and elytra faintly microreticulate.

Hind tibial spurs separated by 2 ciliae.

Abdominal sternites bearing white hairs across mid line.

♀. Differing from ♀ of *lajoyi* in that terminal segment of maxillary palp cylindrical, not dilated proximally; eyes less protuberant; pronotum with median furrow micropunctate; epipleurae dilated over hind coxae and obsolete posteriorly, without discernible membranous border; elytral disc micropunctate; fore tibia with median and distal teeth very strong, bluntly rounded, basal tooth almost obsolete; larger anterior claw minutely toothed at apex; thoracic vestiture white.

*Type locality*.—"Queensland".

*Type location*.—Of *schoenfeldti*, type ♂ in ZM, plesioallotype ♀ in SAM; of *occidentalis*, type ♂ in ZM.

*Specimens examined*.—Types plus 34 ♂♂, 2 ♀♀ (CSIRO; FEW; NM; QDAS; QM; QU; SAM; ZM).

*Distribution*.—QUEENSLAND: Ayr, Dalby, Hermitage, Jandowae, Macalister, Taroom. NEW SOUTH WALES: Bogan R., Trangie.

## 6. Genus HOMOTROPUS Waterhouse

Figs. 110–115

*Homotropus* Waterhouse, 1878, Trans. Ent. Soc. Lond. 1878: 226. Ohaus, 1904, Stettin. ent. Ztg. 65: 68, 148.

Type species *Homotropus luridipennis* Waterhouse, 1878 (by monotypy).

Small species, 10–13½ mm in length.

♂. Labium (e.g. Fig. 110) slightly convex in profile, apically bilobed; labial palp 3-segmented, the terminal segment straight. Maxilla with galea very short, not toothed; palp short, with terminal segment about twice as long as penultimate, broad, with a moderately impressed sensorium. Mandibles with a single apical tooth; molar area not ridged. Labrum with a small anteroventral process. Antenna 10-segmented, the club large, slightly curved, about equal in length to shaft, much longer than terminal segment of maxillary palp.

Clypeus with disc concave and sides recurved, the latter convex in outline, contracted to a slight notch before strongly recurved anterior margin; clypeofrontal suture obliterated, replaced by a posteriorly angulate ridge extending from ocular canthi; the latter developed normally. Head bearing erect hairs; eyes rather prominent.

Pronotum with anterior angles obtuse and bearing dorsal setae; marginal ridges continuous, disc with a vague median longitudinal line.



Elytra coarsely sculptured, intervals costate; epipleurae non-membranous, bearing fine short setae.

Fore tibia 3-dentate; tarsus short, with segments 2-3 together as long as segment 1; claws simple, unequal, the larger strongly built. Prosternum forming a small postcoxal process concealed by dense erect thoracic and coxal vestiture. Mesosternal process not developed. Hind legs slender; tarsus short.

♀. Terminal segments of palps cylindrical; antennal club shorter than shaft, not more than twice length of terminal segment of maxillary palp. Clypeofrontal suture distinct; eyes normal; pronotum strongly convex; fore tibial teeth very strongly developed; fore tarsus with segment 1 = 2-4 = 5. Hind legs robust.

#### KEY TO MALES OF THE GENUS HOMOTROPUS

1. Fore tarsus with segments 1-4 together equal in length to segment 5; costate elytral intervals deeply pigmented and contrasting with lighter coloured striae ..... 1. *luridipennis* Waterh.
- Fore tarsus with segments 1-4 together much longer than segment 5; costate elytral intervals not differentially pigmented ..... 2. *testaceipennis* Ohaus

#### 1. HOMOTROPUS LURIDIPENNIS Waterhouse

Fig. 115

*Homotropus luridipennis* Waterhouse, 1878, Trans. Ent. Soc. Lond. 1878: 227. Ohaus, 1904, Stettin. ent. Ztg. 65: 150.

Small species (10-10½ mm in length). Colour somewhat variable; usually with clypeus reddish brown; frons, pronotum, and scutellum almost black; elytra brownish yellow with intervals darkened; coxae and abdomen yellowish brown. Occasionally the whole head yellowish brown except for a pair of lateral darkened frontal areas, the pygidium black and remainder of abdomen dark reddish brown.

Clypeus with apical truncated face smooth, almost glabrous; sides strongly divergent in proximal third, then broadly rounded, the margin more strongly recurved anteriorly than at sides; disc concave, bearing erect brown hairs. Clypeofrontal suture almost obliterated, appearing posteriorly angulate. Canthi well formed. Frons rugulose anteriorly, heavily punctate towards vertex, bearing hairs on ocular margins.

Pronotum with ridges continuous, both anterior and basal angles obtuse, with sparse long pale dorsal setae borne on lateral thirds of anterior margin; disc with 3 or 4 paired lateral flattenings, strongly but rather sparsely punctate, with a vague median impunctate stripe; surface usually faintly microreticulate. Scutellum punctate, with a broad tuft of grey prescutellar hairs.

Epipleurae strongly defined, lateral setae reddish brown and present almost to apices, there replaced by finer setae arising from dorsal surface below subapical calli; disc with deeply impressed punctate striae, the intervals much more deeply pigmented, the whole surface very irregularly and deeply punctate.

Fore tibia (Fig. 115) strongly 3-dentate, median tooth distinctly closer to distal than to proximal tooth, the latter well formed; tarsus short, with segments 1-4

together only slightly longer than segment 5. Thoracic and coxal villosity white, or pale yellowish grey.

Abdomen with fine pale hairs across middle of sternites; pygidium subvertical, flat, apex truncate, with long pale hairs over whole disc, the surface transversely punctate, somewhat flattened along mid line and compressed at sides.

♀. Unknown.

*Type locality*.—Australia.

*Type location*.—BM.

*Specimens examined*.—12 ♂♂ (AM; JC; NM; QM; QU).

*Distribution*.—QUEENSLAND: Bunya Mountains, Toowoomba. VICTORIA: Alexandra, Morwell.

## 2. HOMOTROPUS TESTACEIPENNIS Ohaus

Figs. 110–114

*Homotropus testaceipennis* Ohaus, 1901, Dtsch. ent. Z. **1901**: 133; 1904, Stettin. ent. Ztg. **65**: 150.

Slightly larger (c.  $13\frac{1}{2}$  mm in length) than *luridipennis*; head, pronotum, scutellum, and pygidium dark brownish black, clypeus suffused with yellowish brown; elytra brownish yellow, undersurface and legs reddish brown.

♂. Anterior truncated face of clypeus deep, glabrous except at sides; sides of clypeus (Fig. 112) diverging from antennal angles almost to mid point, then curved downwards and finally recurved at anterior margin (Fig. 111); whole disc concave, rugulose, bearing numerous posteriorly decumbent long pale yellow hairs, these also present on ocular margins of frons. Clypeofrontal suture posteriorly angulate, discerned as a ridge rather than as a suture; whole head densely and confluent punctate. Ocular canthi slender, with brownish yellow hairs; eyes conspicuous.

Pronotum transverse, ridges continuous, anterior angles very obtuse, sides strongly curved, basal angles well defined; disc setose in anterior angles, finely and sparsely punctate, the punctures becoming denser at sides, confluent and interspersed with micropunctures at edges; with vague trace of a median line. Scutellum with submarginal garland of micropunctures; prescutellum with yellowish hairs.

Elytra with poorly defined epipleurae, disc densely punctate, intervals costate but not deeply pigmented as in *luridipennis*. Fore tibia deeply toothed, with teeth approximately equidistant; claws very unequal, the larger weakly striated. Thoracic and coxal vestiture abundant, yellowish brown to greyish yellow. Prosternal process bluntly rounded, densely setose.

Fore tibia as in Figure 113. Hind legs slender, tibia bicarinate, spurs sharp, subequal in length.

Abdomen with fine hairs across middle of all sternites; pygidium flat, not compressed, with irregular transverse punctures, semidecumbent short white hairs, and longer erect pale yellow hairs increasing in length towards posterior margin. Genitalia as in Figure 114.

♀. Uniformly dark reddish brown except for elytra, these light brownish yellow with intervals and margins darkened. Anterior truncated face of clypeus setose;

clypeofrontal suture forming a distinct posteriorly angulate ridge. Pronotal disc and scutellum punctate, with very numerous micropunctures over whole surface. Fore tibial teeth very strongly toothed, median tooth slightly closer to distal than to proximal tooth.

*Type locality*.—Australia.

*Type location*.—ZM.

*Specimens examined*.—Type ♂ (ZM); ♀, "Vict." (det. as *luridipennis* by Lea) (SAM).

## 7. Genus MESYSTOECHUS Waterhouse

Figs. 116–121

*Mesystoechus* Waterhouse, 1878, Trans. Ent. Soc. Lond. 1878: 227. Carne, 1954, Proc. R. Ent. Soc. Lond. B 23: 40.

Type species *Mesystoechus ciliatus* Waterhouse, 1878 (by monotypy).

Small species, 9–12 mm in length, rather dynastoid in appearance.

♂. Mentum (e.g. Fig. 117) strongly setose, abruptly reflexed before rounded apex. Labial palp small, 3-segmented. Maxilla (e.g. Fig. 116) with galea small, not toothed; palp short, slender, with elongate narrow dorsal sensorium on terminal segment. Mandibles (e.g. Fig. 118) produced beyond clypeus, their margins rounded. Labrum also produced, setose, horizontal, transverse. Antenna 10-segmented, the club slightly sinuate, much longer than shaft.

Clypeus transverse, margin rounded in profile and only moderately recurved; clypeofrontal suture curved anteriorly, obscure in middle; whole head strongly punctate; ocular canthi well developed, setose.

Pronotum punctate, without or with only a trace of a median impressed line; basal ridge obsolete or very fine.

Elytra heavily punctate, the intervals costate; epipleurae non-membranous, coarsely sculptured.

Fore tibia strongly 3-dentate, without a spur; tarsus slender, segments 1–4 much longer than segment 5; claws long, slender, sharp, subequal. Hind tibia bicarinate, spurs long and sharp; tarsus long and slender.

Thorax and abdomen with abundant long hairs; pygidium vertical, convex in profile, with close fine sculpturing. Genitalia with gonostyli slender, distally setose.

♀. Unknown.

This genus is very close to *Chilopocha* but differs in the elytra being strongly costate, the epipleurae non-membranous, the clypeal margin less strongly recurved, and the larger claws being sometimes finely toothed.

### 1. MESYSTOECHUS COSTATUS, sp. nov.

Figs. 116–121

Small species, 10–12 mm in length. Head, pronotum, and scutellum black, with a weak green sheen; elytra with striae pale yellowish brown, costate intervals deep brown; undersurface and pygidium reddish brown, with abundant erect white hairs. Legs, pygidium, and prescutellum with yellowish hairs.



♂. Antennal club reniform, with fine dense oppressed hairs on inner surface, and sparse erect hairs on outer.

Clypeus (Fig. 120) slightly contracted at antennal angles, the sides then slightly convex in outline and finally evenly rounded across front; anterior truncated face oblique, both it and disc rugulose punctate, the former setose. Clypeofrontal suture obliterated, the surface depressed; frons as for clypeus, ocular canthi broad, bearing brownish yellow setae.

Pronotum widest at well-defined basal angles, sides contracted towards normal or subacute anterior angles, with point of inflexion two-thirds distance from base; basal margin with ridge widely obsolete across middle, bilaterally somewhat compressed; disc with dense heavily impressed punctures, the surface slightly depressed along mid line but not forming a distinct median furrow. Scutellum with a band of punctures near margin.

Elytral disc heavily punctate, wrinkled; sutural intervals punctate, the other intervals smooth, strongly costate; humeral calli distinct, subapical calli obsolete; epipleurae not defined anterior to level of hind coxae, elsewhere margins rugose, non-membranous, bearing reddish yellow setae.

Fore tibia (Fig. 119) with median tooth closer to distal than to proximal tooth, teeth sharp, surface with setiferous punctures; fore tarsus elongate, with segments 1-4 together much longer than segment 5; claws unequal, simple. Hind femur clothed with long hairs, tibia with long reddish brown ciliae, spurs long and sharp.

Abdomen with sparse erect hairs across middle of each sternite; pygidium vertical, weakly convex in profile, with long hairs near margins and sparse short decumbent hairs near angles; surface transversely punctate, microreticulate, apex narrowly rounded. Genitalia as in Figure 121.

♀. Unknown.

*Type locality*.—Toowoomba, S.Qld.

*Type location*.—QU.

*Specimens examined*.—Holotype ♂, "Too'ba, 3.1.22", 3 paratype ♂♂, 2 labelled as holotype, one with "Toowoomba" in full (CSIRO; QU).

## 2. MESYSTOECHUS CILIATUS Waterhouse

*Mesystoechus ciliatus* Waterhouse, 1878, Trans. Ent. Soc. Lond. **1878**: 228. Ohaus, 1904, Stettin. ent. Ztg. **65**: 162. Arrow, 1907, Ann. Mag. Nat. Hist. (7) **19**: 357. Ohaus, 1934, Gen. Ins. **199A**: 4. Carne, 1954, Proc. R. Ent. Soc. Lond. **B23**: 36.

Small (9-11 mm in length) yellowish brown species; frons and scutellum dark brownish black, pronotum with variable pattern of similar pigment (when fully developed this pattern consists of a median longitudinal zone broadening posteriorly, and a pair of symmetrical lateral curved bands). Sides of coxae, femora, and abdominal tergites light brownish yellow; abdominal sternites, pygidium, and legs dark brown.

♂. Antennal club finely setose on inner face, glabrous on outer.

Clypeus with margin rounded from base, weakly recurved; disc glabrous, rugosely punctate; clypeofrontal suture not depressed, quite distinct at sides;

frons with triangular median flattening, more coarsely sculptured than clypeus. Ocular canthi truncated at ends, bearing pale brown setae.

Pronotum with basal ridge fine but continuous, sides evenly rounded, anterior angles normal, basal angles obtuse, disc with slight bilateral impressions and with trace of a median impressed line on anterior third only. Scutellum elongate, punctate.

Elytra with calli well defined, punctures deeply impressed and forming distinct striae, intervals costate but not differentially pigmented; epipleurae coarsely rugose posterior to level of mesocoxae, bearing dark brown setae almost to apices.

Fore tibia setose, with median tooth closer to distal than to proximal tooth, the teeth deeply separated; larger claws of all legs usually with minute tooth set back from apex. Hind legs stout, femur setose, tibia with short sharp ciliae.

Abdomen and pygidium bearing long white hairs, latter concentrically rugulose, apical ridge somewhat broadened in middle.

♀. Unknown.

*Type locality*.—Moreton Bay, Qld.

*Type location*.—BM.

*Specimens examined*.—15 ♂♂ (CSIRO; NM; QU; SAM).

*Distribution*.—QUEENSLAND: Brisbane, Darra. NEW SOUTH WALES: Clarence R.

## 8. Genus CLILOPOCHA Lea

*Clilopocha* Lea, 1914, Trans. Roy. Soc. S. Aust. **38**: 452.

*Dynastomorphus* Carne, 1954, Proc. R. Ent. Soc. Lond. B **23**: 36; 1955, Proc. Linn. Soc. N.S.W. **80**: 137.

Type species *Clilopocha whiteae* Lea, 1914.

## 9. Genus DUNGOORUS, gen. nov.

Figs. 122–128

Type species *Dungoorus murrumbullus*, sp. nov.

A unique ruteline in the collection of the Queensland Museum differs so strikingly from all other representatives of this subfamily in Australia that it cannot be referred to any existing genus.

♂. Mentum with apex rounded, not recurved into mouth cavity. Terminal segments of labial and maxillary palps very large, with deeply impressed dorsal sensoria. Mandibles strongly built, their apices produced beyond clypeus and strongly upcurved. Labrum rugulose, transverse, anteriorly concave in profile. Antenna 9-segmented, club as long as shaft.

Clypeus strongly narrowed towards recurved anterior margin. Clypeofrontal suture clearly defined, trisinate.

Epipleurae bearing lateral setae almost to apices, non-membranous, slightly arched over hinder part of abdomen.

Fore tibia 3-dentate; tarsus with segments 1–4 together equal in length to segment 5; claws simple, unequal. Prosternum forming a small setose postcoxal process. Mesosternal process not developed.

♀. Unknown.

The name is derived from an aboriginal word meaning "a stranger".

*DUNGOORUS MURRUMBULLUS*, sp. nov.

Figs. 122–128

Concolorous yellowish brown species, *c.* 12 mm in length. Anterior clypeal margin, mandibles, and fore tibial teeth black; eyes dark, anterior pronotal margin dark brown. Thoracic and coxal vestiture yellowish brown.

♂. Labial palp stout, terminal segment greatly enlarged, obovate, with deeply impressed sensorium occupying its entire length (Fig. 123). Maxillary palp similarly modified, terminal segment as long as antennal club, sensorium very deeply impressed. Antennal club elongate, slender, setose.

Clypeus as in Figures 122–124; apical truncated face deep, setose; disc with rugose confluent punctation and bearing long erect hairs. Ocular canthi slender. Frons flattened, with discrete punctures except near suture, bearing sparse setae on ocular margins; vertex strongly convex in profile, with rather distinct and distorted punctures.

Pronotum transverse, basal and especially anterior angles obtuse, sides gently rounded, marginal ridges continuous, basal margin rather strongly produced in middle, anterior margin with a few dorsal setae near angles, lateral ridges with a few setae on extreme edges; disc glabrous, strongly punctate, with a vaguely defined median line; surface micropunctate, with scattered groups of micropunctures and a pair of conspicuous lateral pigmented impressions. Scutellum impunctate.

Elytra with slight transverse furrow near scutellum; humeral calli well defined, sparsely setose at angles; subapical calli subobsolete; epipleurae distinct; apices contiguous but not squarely cut; disc glabrous, weakly microreticulate, shallowly punctate, slightly wrinkled.

Fore tibia (Fig. 125) with teeth very sharp, surface rugulose except on edges of teeth; tarsus stout, claws long, feebly striated. Hind legs (Fig. 128) slender, femur clothed with long hairs; tibia unicarinate, spurs long, sharp, separated by 1 or 2 ciliae.

Pygidium subvertical, weakly convex in profile, apex rounded, disc with long erect hairs near margins but glabrous in middle and strongly microreticulate, closely but shallowly punctate. Genitalia (Figs. 126, 127) extruded in type specimen, aedeagus exerted ventrally, parameres connected dorsally by a thin membrane.

The lack of an incurved labial process places this genus in the subtribe *Schizognathina*. Its untoothed claws, apposable mandibles, and the absence of scales on the body surface associate it with *Saulostomus*. However, it differs very markedly from this genus in a number of characters, notably the form of the mandibles, palps, and clypeus, and in having non-membranous epipleurae.

The trivial name is derived from an aboriginal word connoting "canoe-shaped", and refers to the form of the maxillary palps.



*Type locality*.—Presumably Queensland. The type lacks a locality label, but has a note "Probably n.g. near *Saulostomus*, claws uneven, palpi curious" in Lea's handwriting, and also "Lea has not, 13.12.18". These labels suggest strongly that the specimen was sent from the Queensland Museum to Lea for identification as a Queensland insect.

*Type location*.—QM.

## 10. Genus MIMADORETUS Arrow

Figs. 129, 130

*Popillia* Macleay, 1887 (nec Serv. 1825), Proc. Linn. Soc. N.S.W. 2: 227.

*Mimadoretus* Arrow, 1901, Ann. Mag. Nat. Hist. (7) 7: 398. Ohaus, 1904, Stettin. ent. Ztg. 65: 68, 158.

Type species *Popillia flavomaculata* Macleay, 1887 (by monotypy).

Small species (8–15 mm in length), dorsal surface clothed with adpressed white scales or semidecumbent white hairs.

♂. Mentum flat, apex gently concave in outline; labial palps 3-segmented. Maxilla with galea strongly toothed; palps slender, their terminal segments fusiform, with sensoria scarcely impressed. Labrum transverse, triangular apex concealed by mouthparts. Mandibles with acute apical tooth; molar areas ridged. Antenna 10-segmented, club shorter than shaft but longer than last segment of maxillary palp.

Clypeus transverse, anterior angles rounded, margins slightly recurved; clypeo-frontal suture transverse.

Pronotum with anterior angles acute or subacute; disc smooth in middle and without an impressed median line; basal margin rounded, or weakly bilobed, over scutellum.

Elytra strongly punctate, calli well defined; epipleurae narrowly membranous.

Fore tibia bidentate or weakly tridentate; fore tarsus with segment 1 shorter than segment 5; claws large, curved, sharp, unequal. Postcoxal prosternal process well developed, obliquely truncate. Hind tibia bicarinate; spurs long, sharp, subequal; last tarsal segment with a conspicuous ventral projection.

♀. Fore tarsus with segment 1 elongate, and equal in length to segment 5; larger claws distinctly toothed.

### KEY TO SPECIES OF THE GENUS MIMADORETUS

1. Dorsal surface with recumbent white hairs; fore tibia distinctly 3-dentate; without a spur.  
Length c. 11 mm ..... 1. *leucothyreus* Lea, ♂
- Dorsal surface with adpressed white scales; fore tibia 2-dentate, or with basal tooth represented by an obtuse sinuation; spur present ..... 2
- 2(1). Small species (8–10 mm in length), scales on elytra yellow, grouped into several dense patches extending across intervals (Fig. 130); fore tarsus of ♂ with ventral tufts of fine silky hairs ..... 2. *flavomaculatus* (Mael.)
- Larger species (12–15 mm in length), scales on elytra white, regularly present along striae, absent from intervals ..... 3. *niveosquamosus* Lea, ♀

1. *MIMADORETUS LEUCOTHYREUS* Lea

*Mimadoretus leucothyreus* Lea, Trans. Roy. Soc. S. Aust. **43**: 245, pl. 27, fig. 77.

Shining reddish brown species c. 11 mm in length; pronotum, scutellum, and elytra with conspicuous long white recumbent hairs.

♂. Terminal segment of maxillary palp more than half length of antennal club, rather swollen, tapered apically, sensorium superficial. Antennal club slightly shorter than shaft, as long as clypeus is wide. Clypeus transverse, anterior truncated face setose, margins moderately recurved, disc coarsely punctate, bearing short erect yellowish hairs anteriorly; clypeofrontal suture obliterated; frons coarsely punctate, with fine white hairs on ocular margins.

Pronotum with ridges continuous, sides angulate in middle, slightly contracted behind subacute anterior angles; disc closely and heavily punctate, without a median furrow, bearing long recumbent white hairs on lateral thirds. Scutellum densely clothed with similar hairs.

Elytra with deeply impressed punctate striae, with numerous white hairs lining the striae and on apical third of sutural interval; these hairs admixed with abundant erect yellow hairs on epipleurae, the latter conspicuously membranous.

Fore tibia 3-dentate, teeth equidistant, proximal tooth very small and obtuse, spur lacking; fore tarsus slender, segments 1–3 together as long as segments 4–5 together; claws large, slender, simple. Thorax and legs abundantly clothed with long white hairs; hind legs strongly built, tibia bicarinate, spurs short, unequal, separated by 2 ciliae; hind tarsus short. All claws simple.

Abdomen with sparse long white hairs and very numerous decumbent hairs. Pygidium sloping, flat in profile, with dense decumbent white hairs and sparse long erect yellow hairs on and near margin.

♀. Unknown.

*Type locality*.—Cairns, Qld.

*Type location*.—SAM.

*Specimens examined*.—2 ♂♂, including type (SAM).

2. *MIMADORETUS FLAVOMACULATUS* (Macleay)

Fig. 130

*Popillia flavomaculata* Macleay, 1887, Proc. Linn. Soc. N.S.W. **2**: 227.

*Mimadoretus flavomaculatus* Arrow, 1901, Ann. Mag. Nat. Hist. (7) **7**: 398. Ohaus, 1904, Stettin. ent. Ztg. **65**: 160.

♂. Dark reddish brown, elytra almost black; length 8–10 mm. Palps small, sensoria basodorsal. Mandibles and labrum level with anterior margin of clypeus, the latter short and setose. Clypeus transverse, sides straight, anterior angles rounded, anterior margin recurved, sides almost flat. Clypeofrontal suture subobsolete, apparently transverse; ocular canthi slender, short; head with shallow confluent punctuation, bearing adpressed yellowish scales.

Pronotum with well-defined basal angles, anterior angles acute, both anterior and basal ridges obsolete across middle, disc broadly impunctate along mid line,

with scattered punctures near anterior margin, sides closely punctate, bearing scales as on head. Scutellum with a few scales at base, otherwise glabrous. Elytra with small shallow distorted punctures forming rows, with irregular patches of scales (Fig. 130), calli moderately well defined; epipleurae broad, bearing scales, obsolete before apices. Fore tibia bidentate, spur present, tarsus with segments 1-4 together as long as segment 5, first 3 segments with ventral brushes of fine silky hairs; claws slender, simple. Thorax with surface clothed with scales. Hind tibia bicarinate, ciliae small and stout, spurs long and sharp; tarsus short, stout, with segments 1-4 together as long as segment 5.

Abdomen with dense scales except on mid line, 4th and 5th sternites with sparse white hairs across middle, the 6th rugose and bearing brown setae on hind margin. Pygidium vertical, almost flat, densely clothed with scales, and with sparse fine pale hairs near margin, the marginal ridge with apex rounded and divided.

♀. Light yellowish brown. Cephalic and pronotal scales coarser: fore tibial teeth less closely approximated; fore tarsus with segments 1 and 5 each equal in length to segments 2-4 together; without ventral tufts of fine hairs, claws shorter, the larger distally toothed. Pygidium convex in profile.

*Type locality*.—Barron R. (Cairns district), N. Qld.

*Type location*.—MACL (but could not be found).

*Specimens examined*.—18 (CSIRO; NM; QM; SAM).

*Distribution*.—QUEENSLAND: Babinda, Barron R., Cardwell, Innisfail, Kuranda.

Dodd (1917) states that this species occurs in scrublands about Babinda and Innisfail, and flies to lights at night.

### 3. *MIMADORETUS NIVEOSQUAMOSUS* Lea

Fig. 129

*Mimadoretus niveosquamosus* Lea, 1919, Trans. Roy. Soc. S. Aust. **43**: 244, pl. 27, fig. 76.

Rather flattened, shining reddish brown species, 12-15 mm in length, with adpressed white scales on dorsal surface; margins darkened, middle and hind tarsi reddish black.

♀. Mouthparts other than labrum sparsely setose; palps small, sensoria of terminal segments superficial. Clypeus (Fig. 129) transverse, rectangular, with anterior angles rounded, truncate face short, sparsely setose; disc rugulose, bearing recumbent white hairs; clypeofrontal suture slightly arcuate anteriorly; frons rugulose anteriorly, with coarse discrete punctures towards vertex, and with adpressed white scales on anterior and ocular margins. Ocular canthi short, transverse, bearing white hairs.

Pronotum weakly bilobed at middle of basal margin, anterior angles acute, disc with sparse impressed punctures on median half, lateral quarters more densely punctate and bearing scales, disc also with very fine micropunctuation and a vague median impunctate stripe. Scutellum glabrous, with coarse marginal punctures.

Elytra with 12 well-defined dark striae bearing double rows of scales, intervals smooth and shining, impunctate; scales also present on sutural margins and on



epipleurae, the latter slightly flared over hind coxae; subapical calli very close to apices, humeral calli dark.

Fore tibia bidentate, proximal third tooth represented by a weak sinuation, bearing white scales and fine yellowish hairs, spur present; fore tarsus slender, with larger claws distally toothed. Hind legs stout, densely clothed with scales, tibia bicarinate, ciliae reddish brown, spurs with apices rounded, unequal, separated by 2 ciliae; hind tarsus short, segments 1–4 together slightly longer than segment 5; claws of both middle and hind legs simple.

Abdomen bearing dense scales across whole width, and with sparse erect yellowish grey hairs, especially on last sternite; pygidium weakly convex in profile, micropunctate, transversely strigose, bearing dense scales (as also propygidium), apical ridge and adjacent surface of disc with long erect pale yellow hairs.

♂. Unknown.

*Type locality*.—South Johnstone R., Qld.

*Type location*.—SAM.

*Specimens examined*.—♀ type plus 5 ♀♀ (QDAS; QM; QU; SAM).

*Distribution*.—QUEENSLAND: Johnstone R. area.

### 11. Genus SAULOSTOMUS Waterhouse

*Saulostomus* Waterhouse, 1878, Trans. Ent. Soc. Lond. **1878**: 225. Carne, 1956, Proc. Linn. Soc. N.S.W. **81**: 62 (revision).

Type species *Saulostomus villosus* Waterhouse, 1878.

### 12. Genus EOSAULOSTOMUS Carne

*Eosaulostomus* Carne, 1956, Proc. Linn. Soc. N.S.W. **81**: 67.

Type species *Eosaulostomus excisus* Carne, 1956.

### 13. Genus AMBLYTERUS Macleay

Figs. 131–156

*Amblyterus* Macleay, 1819, Horae Ent. **1**, app. p. 142. Boisduval, 1835, Voy. Astrolabe, Col. **2**: 185. Burmeister, 1844, Handb. Ent. **4**(1): 457; 1855, op. cit. **4**(2): 525; Ohaus, 1904, Stettin. ent. Ztg. **65**: 68, 162.

Type species *Amblyterus geminatus* Macleay, 1819 (by monotypy) = *Melolontha cicatricosa* Gyllenhal, 1817.

Strongly built dark reddish brown or reddish black beetles; mandibles and labrum produced beyond margin of clypeus; pronotum with all angles usually distinctly obtuse, the sides contracted in front of basal angles; usually with the larger claws of all legs toothed.

♂. Mentum flat, apex rounded or very slightly lobed; labial palps swollen at base, tapering distally. Maxilla with strongly developed teeth, palp elongate and with segment 5 as long as segments 1–4 together, the former with a conspicuous dorsal or lateral sensorium. Labrum transverse, horizontal, rugose, and set with strong

bristles. Mandibles strongly rounded and recurved dorsally; molar areas ridged. Antenna 10-segmented, club equal in length to, or shorter than, shaft. Clypeus transverse, rounded, rarely slightly truncate, margins slightly to moderately recurved, both clypeus and frons confluent and coarsely punctate; clypeofrontal suture transverse or slightly arcuate posteriorly, often obliterated in middle. Ocular canthi rounded or truncated at ends.

Pronotum with disc heavily punctate, marginal ridges usually continuous. Elytra with intervals 2, 4, and 6 irregularly punctate; intervals 3, 5, and 7 smooth, often subcostate; epipleurae setose almost or quite to apices, narrowly membranous.

Fore tibia strongly 3-dentate; fore tarsus elongate, with segment 1 longer than segment 2, segments 1-4 often with ventral tufts of fine setae. Prosternum forming a small postcoxal process concealed by dense erect thoracic villosity. Hind legs strongly built, tibia 1- to 3-carinate, spurs short, corbel asperate, last tarsal segment usually with a ventral notch.

Abdomen and pygidium densely clothed; the latter vertical, weakly to moderately convex in profile.

♀. Maxillary teeth reduced, palps more slender; antennal club always shorter than shaft. Clypeus with margins less, or not at all recurved, the disc often strongly elevated or ridged. Fore tibia very strongly built; fore tarsus with segment 1 twice as long as segment 2, never with ventral tufts of fine hairs. Hind tibial spurs shorter. Pygidium sloping, weakly convex or flat in profile.

All the previously described species of *Amblyterus* have the larger claws of all legs toothed. A new species here described (*deuqueti*) differs in having simple claws. *A. tarsalis* Lea, and two new species, have the fore tarsal segments of the ♂ clothed centrally with dense tufts of fine silky hairs. This character is also seen in the ♂ of *Mimadoretus flavomaculatus*.

#### KEY TO SPECIES OF THE GENUS AMBLYTERUS

1. Claws of all legs simple, untoothed; margins of pronotum bearing dorsal white hairs; last segment of maxillary palp (Fig. 132) with a superficial sensorium. 12½-14 mm in length. Northern N.S.W. (Richmond R.) ..... 1. *deuqueti*, sp. nov.  
 Larger claws of all legs toothed, obviously so in ♀, finely so in ♂; pronotum with margins glabrous except occasionally near anterolateral angles; last segment of maxillary palp with deeply impressed sensorium ..... 2
- 2(1). Fore tibia with a small spur below insertion of tarsus (Fig. 147); fore tarsus of ♂ without ventral tufts of fine hairs ..... 3  
 Fore tibia without a spur; fore tarsus of ♂ with segments 1-4 clothed ventrally with tufts of fine silky hairs (e.g. Fig. 146) ..... 4
- 3(2). Last segment of hind tarsus with a small ventral notch (Fig. 145); last segment of maxillary palp shorter than mid length of clypeus; fore tibial teeth equidistant. Medium reddish brown species, c. 13 mm in length. Northern N.S.W. (Clarence R.) .....  
 ..... 2. *simplicitarsus*, sp. nov., ♂  
 Last segment of hind tarsus without a notch (Fig. 148); last segment of maxillary palp (Fig. 135) longer than mid length of clypeus; fore tibial teeth unevenly spaced, median closer to distal than to proximal tooth; disc of clypeus greatly swollen in ♀. Dark reddish black species, ♂ 14-17 mm, ♀ 19-22 mm in length. N.S.W. and S. Qld. coastal districts ..... 3. *cicatricosus* (Gyll.)

- 4(2). Epipleurae bearing lateral setae becoming progressively longer anteriorly, usually quite conspicuous; clypeus setose or glabrous; ocular canthi with ends rounded or truncate... 5
- Epipleurae with lateral hairs not becoming appreciably longer anteriorly (except at extreme humeral angles), quite inconspicuous; clypeus glabrous; ends of ocular canthi truncate ..... 6
- 5(4). Fore tibial teeth equidistant; clypeus setose at sides near clypeofrontal suture, surface swollen; ends of ocular canthi truncate; disc of pygidium with sparse short brownish yellow hairs; length 17–22½ mm. Qld. .... 4. *clypealis* Ohaus, ♀
- Fore tibial teeth unequally spaced, median tooth closer to proximal than to distal tooth; clypeal disc quite glabrous and flat in ♂, setose and transversely ridged (Fig. 138) in ♀; ends of ocular canthi rounded; pygidium with disc bearing abundant long decumbent white hairs; length 15–19 mm. S. Qld. .... 5. *tarsalis* Lea
- 6(4). Smaller hind tibial spur of ♂ obviously less than half length of larger spur; fore tibial teeth relatively slender (Fig. 149); hind tarsal segments 3–5 without trace of longitudinal grooves; length c. 13–14½ mm. S. Qld. .... 6. *bundabergensis*, sp. nov., ♂
- Smaller hind tibial spur of ♂ at least half length of larger spur; fore tibiae (Fig. 150) relatively broader; hind tarsal segments 1–4 with strong longitudinal grooves; length c. 15 mm. Australia ..... 7. *tibialis*, sp. nov., ♂

# 1. AMBLYTERUS DEUQUETI, sp. nov.

Figs. 131, 132, 144, 151

Dark reddish brown species, suffused with irregular areas of reddish black on pronotum, c. 12½–14 mm in length.

♂. Antennal club equal in length to shaft; labrum and mandibles slightly produced, the former rounded in profile; terminal segment of maxillary palp (Fig. 132) shorter than mid length of clypeus, with sensorium broad but not impressed. Clypeus (Fig. 131) glabrous, highly transverse; sides briefly parallel at base, then strongly rounded; margins strongly recurved. Clypeofrontal suture transverse, elevated in middle; frons with erect brownish yellow hairs over whole surface; ocular canthi truncated at ends.

Pronotum dorsally setose on and near all margins; sides (Fig. 144) not contracted in front of basal angles, anterior angles subacute; disc with a vague median furrow containing a few micropunctures near base. Scutellum with dense setiferous punctures over whole surface.

Elytra with sparse setae on disc near lateral margins; intervals 3, 5, and 7 with a few small punctures; epipleurae not defined by ridges, setose almost to apices.

Fore tibia without spurs, shallowly and evenly 3-dentate, the teeth equidistant; fore tarsus without ventral tufts of fine hairs. Thoracic villosity brownish yellow. Hind tibia bicarinate but with proximal carina subobsolete; spurs very short, blunt, the smaller spur more than half the length of the larger. Hind tarsus with segments 1–2 with distinct longitudinal grooves, segment 5 with a small ventral notch. Claws of all legs slender, sharp, and untoothed.

Abdomen with both decumbent and semi-erect hairs across middle. Pygidium vertical, weakly convex, disc with dense shallow annulate punctures bearing decumbent hairs and longer erect hairs near margin, the sides not compressed. Genitalia as in Figure 151.



♀. Antennal club shorter than shaft; both clypeus and frons setose. Pronotum with basal ridge glabrous in middle; scutellum glabrous, as also elytra. Proximal fore tibial tooth less than half height of median tooth. Hind legs stouter than in ♂, spurs even shorter and blunter. Propygidium black, pygidium sloping, less abundantly clothed.

*Type locality*.—Richmond, N.S.W.

*Specimens examined*.—Holotype ♂ and allotype ♀, "Richmond, N.S.W. C. F. Deuquet" (CSIRO, presented by the collector).

## 2. *AMBLYTERUS SIMPLICITARSUS*, sp. nov.

Figs. 133, 145, 152

Medium reddish brown species, *c.* 13 mm in length.

♀. Antennal club slightly shorter than shaft; labrum slightly produced, anterior margin almost straight; maxillary palp (Fig. 133) with deeply impressed slit-like sensorium. Clypeus (Fig. 133) transverse, rounded from base, margins very slightly recurved, disc glabrous; clypeofrontal suture transverse, flat, obliterated in middle; frons setose on ocular margins; ocular canthi rounded at ends.

Pronotum glabrous, sides weakly contracted in front of basal angles, disc without micropunctures; scutellum impunctate.

Elytral striae moderately impressed, intervals 3, 5, and 7 not costate, disc glabrous, epipleurae defined by ridges, subobsolete and glabrous near apices.

Fore tibia with a small spur, lateral teeth equidistant but with proximal tooth half height of median tooth; tarsus slender, in length segments  $1+2+3 = 4+5$ , without tufts of ventral hairs. Thoracic vlosity brownish yellow. Hind legs slender, tibia bicarinate, spurs unequal, the smaller one sharp. Hind tarsus with segment 1 longitudinally grooved, segment 5 (Fig. 145) with a small ventral notch. Larger claws of all legs toothed.

Abdomen densely clothed; pygidium vertical, weakly convex, with fine transversely distorted punctures bearing short decumbent hairs directed towards mid line, and longer erect pale yellow hairs near edges. Genitalia as in Figure 152.

♀. Unknown.

*Type locality*.—Clarence R., N.S.W.

*Specimens examined*.—Holotype ♂, "Clarence R., N.S.W." (MACL).

## 3. *AMBLYTERUS CICATRICOSUS* (Gyllenhal)

Figs. 134, 135, 147, 148, 153

*Melolontha cicatricosa* Gyllenhal, in Schönherr, 1817, Syn. Ins. 1(3), app. p. 113.

*Amblyterus cicatricosus* Burmeister, 1844, Handb. Ent. 4(1): 458. Ohaus, 1904, Stettin. ent. Ztg. 65: 164.

*Amblyterus geminatus* Macleay, 1819, Horae Ent. 1, app. p. 142.

Dark reddish black species with conspicuously enlarged maxillary palps.

♂. Length 14–17 mm. Antennal club equal in length to shaft; labrum slightly produced beyond margin of clypeus, its anterior margin straight; maxillary palp with terminal segment (Fig. 135) enlarged, pointed, almost as long as antennal club,

with a deep slit-like lateral sensorium. Clypeus (Fig. 134) with sides briefly parallel at base, then broadly rounded, the margins evenly and slightly recurved; disc glabrous, clypeofrontal suture apparently posteriorly arcuate in middle, almost obliterated; ocular canthi rounded at ends; frons with ocular margins bearing a few erect setae.

Pronotum glabrous except for a few fine hairs on ridge at anterior angles, sides not appreciably contracted in front of basal angles; disc with incomplete annular punctures and with a faint median line; anterior and basal ridges sometimes interrupted across middle. Scutellum with punctures similar to those of pronotum.

Elytra glabrous, striae irregular, epipleurae defined by ridges, bearing conspicuous long brownish yellow hairs except near apices.

Fore tibia (Fig. 147) with a small spur, with median tooth closer to distal than to proximal tooth, the latter more than half the height of median tooth; fore tarsus much longer than tibia, in length segments  $1+2+3 = 4+5$ , without ventral tufts of fine hairs. Thoracic villosity pale yellow. Hind tibia bicarinate; spurs short and blunt, smaller spur less than half the length of larger, the latter longer than the intervening ciliae; 5th tarsal segment (Fig. 148) without a ventral notch, the first 2 segments longitudinally grooved. All the larger claws toothed.

Abdomen clothed with short decumbent hairs, especially at sides, and with longer erect hairs the apices of which are bent posteriorly. Pygidium vertical, convex, with short decumbent white hairs and long erect pale yellow hairs over most of disc, the latter with shallow, transversely distorted punctures. Genitalia as in Figure 153.

♀. Length 19–23 mm. Antennal club shorter than shaft; maxillary palp shorter, the sensorium of the terminal segment indicated only by a fine dark line; mandibles more strongly produced than in ♂. Clypeus transversely swollen, margin not recurved but with a fine ridge often lost by abrasion. Ocular margins of frons with erect brownish yellow hairs. Scutellum almost impunctate. Fore tibial teeth stronger, more or less equidistant, proximal tooth *c.* half height of median tooth; tarsus relatively shorter than in ♂, in length segments  $1+2 = 3+4+5$ . Hind legs stouter than in ♂, spurs shorter, less sharp, the larger spur shorter than the intervening ciliae. Pygidium less convex.

*Type locality*.—"New Holland".

*Type location*.—NRS.

*Specimens examined*.—♂ type plus 51 (BSES; CSIRO; FEW; MACL; NM; QDAS; QM; QU).

*Distribution*.—QUEENSLAND: Brisbane, Bundaberg, Childers, Jandowae, Narko, Toowoomba. NEW SOUTH WALES: Galston, Sydney.

#### 4. *AMBLYTERUS CLYPEALIS* Ohaus

Figs. 136, 141

*Amblyterus clypealis* Ohaus, 1904, Stettin. ent. Ztg. **65**: 165.

Dark reddish brown species, 17–22½ mm in length.

♀. Antennal club only slightly shorter than shaft; terminal segment of maxillary palp shorter than mid length of clypeus, with elongate impressed sensorium;

labrum distinctly concave in profile, produced beyond margin of clypeus. Clypeus (Fig. 136) with sides subparallel at base, then rounded, the margins depressed towards apex, not recurved; disc swollen, with a few erect yellowish setae at sides (abraded in cotype); clypeofrontal suture transverse, slightly depressed; ocular canthi truncated at ends.

Pronotum glabrous, marginal ridges continuous, anterior margin broadened at middle, sides (Fig. 141) strongly contracted in front of basal angles, the latter scarcely obtuse; disc with a median longitudinal furrow. Scutellum glabrous, punctate in middle.

Elytra glabrous, with intervals 3, 5, and 7 subcostate; epipleurae defined by ridges, with rather sparse lateral hairs except near apices, the hairs darker than the light brownish yellow thoracic villosity.

Fore tibia without spurs, the teeth strong, equidistant, proximal tooth half height of median tooth; tarsus elongate, in length segment 1 = 2+3+4 = 5. Hind legs strong, tibia 3-carinate; spurs short, stout, blunt, separated by *c.* 10 ciliae, larger spur almost twice length of smaller; tarsus with segment 1 longitudinally grooved, segment 5 with a ventral notch. Larger claws of all legs toothed.

Abdomen with decumbent hairs at sides only, with a single row of fine erect brownish yellow hairs across middle. Pygidium sloping, sides lightly compressed, disc flat, with shallow irregular punctures bearing short decumbent brownish yellow hairs on disc and longer erect hairs near hind margin.

♂. Unknown. The Berlin Museum has a male specimen with mouthparts dissected and labelled "*clypealis*" by Ohaus, but it is not conspecific with a female labelled as a cotype in the same collection. As Ohaus stated "I have seen only a single ♀ of this species" there can be no true cotype, but the specimen agrees in all important respects with his description of the type ♀, although it is considerably smaller (17 compared to 22½ mm in length) and lacks a green sheen on the margins of the pronotum.

*Type locality*.—Cleveland, Qld.

*Type location*.—ZM.

*Specimens examined*.—♀, labelled as a cotype in Ohaus's handwriting (ZM); ♀, "1700 N, *Dasygnathus* sp." (NM); ♀, "Childers, Q., 14.12.26" (SAM).

*Distribution*.—QUEENSLAND.

## 5. *AMBLYTERUS TARSALIS* Lea

Figs. 137, 138, 146, 154

*Amblyterus tarsalis* Lea, 1919, Proc. Linn. Soc. N.S.W. 44: 744.

Dark reddish brown species, 18–19 mm in length.

♂. Antennal club equal in length to shaft; terminal segment of maxillary palp with a long deeply impressed slit-like sensorium; mandibles and labrum strongly produced beyond margin of clypeus, the labrum with anterior margin straight.



Clypeus (Fig. 137) with sides briefly parallel at base, then abruptly convergent towards rounded apex; sides moderately, anterior margin strongly recurved. Head glabrous, flat; clypeofrontal suture transverse; ocular canthi rounded at ends.

Pronotum with a few small hairs in anterior angles, otherwise glabrous; marginal ridges continuous, sides contracted in front of basal angles, disc with a pair of shallow anterolateral depressions and a vague median line; scutellum glabrous, punctate in middle.

Elytra with intervals, 3 5, and 7 not costate; epipleurae defined by ridges with lateral hairs present to apices although very short there, the hairs of the same yellowish white colour as those of the thorax.

Fore tibia without a spur, teeth strongly developed, proximal tooth more than half height of median tooth, the latter closer to proximal than to distal tooth; fore tarsus (Fig. 146) with segments 1-4 bearing dense ventral tufts of silky hairs, in length segment 1 = segments 2+3+4. Hind tibia bicarinate, spurs slender, unequal; hind tarsus with segments 1-2 longitudinally grooved, segment 5 with a strong ventral notch. Larger claws of all legs toothed.

Propygidium reddish brown; pygidium reddish brown to almost black, sub-vertical, weakly convex, sides only slightly contracted, disc with dense fine transversely distorted punctures, densely clothed with rather long depressed almost white hairs. Abdomen with abundant yellowish white hairs across middle. Genitalia as in Figure 154.

♀. Antennal club slightly shorter than shaft; mandibles more strongly recurved than in ♂. Clypeus (Fig. 138) with a conspicuous transverse ridge, and with erect hairs near margins, the latter depressed at sides, nowhere recurved except briefly at apex. Scutellum less heavily punctate. Fore tibial teeth even more strongly developed than in ♂, fore tarsus with segment 1 longer than segments 2+3+4, without ventral tufts of fine hairs; hind tibial spurs shorter, less acute. Pygidium sloping, flat, with more numerous erect long hairs near margin than in ♂.

*Type locality*.—Dalby, Qld.

*Type location*.—SAM.

*Specimens examined*.—Cotype ♂, "Dalby, Q., Mrs. F. H. Hobler" (SAM); 2 ♂♂, "Milmerran, 8.1.26, K63825"; 1 ♀, ditto, "K63823" (AM).

*Distribution*.—QUEENSLAND.

The ♀ of this species has not been described earlier, and that in the Australian Museum has been designated as a *plesioallotype*.

## 6. AMBLYTERUS BUNDABERGENSIS, sp. nov.

Figs. 139, 142, 149, 155

Dark reddish brown species, pronotum with a distinct green sheen, *c.* 13-14½ mm in length.

♂. Antennal club narrowed distally, equal to or slightly longer than shaft; terminal segment of maxillary palp with a broad oval impressed sensorium; mandibles and labrum strongly produced beyond margin of clypeus, the labrum with margin

straight or slightly concave. Clypeus (Fig. 139) narrowed from base, rounded anteriorly, margin evenly recurved. Head glabrous, clypeofrontal suture transverse, frons sometimes slightly depressed at sides behind suture, otherwise the whole surface flat; ocular canthi truncated at ends.

Pronotum glabrous, basal ridge sometimes briefly obsolete across middle, sides (Fig. 142) slightly contracted in front of basal angles, the latter obtuse; disc with a few micropunctures in posterior third of subobsolete median furrow; scutellum glabrous, finely punctate in middle.

Elytra with regularly punctate striae, intervals 3, 5, and 7 not costate; epipleurae defined by ridges, lateral hairs darker than those of thorax, not becoming appreciably longer anteriorly.

Fore tibia (Fig. 149) without spurs; lateral teeth sharp, equidistant, proximal tooth less than half height of median tooth; fore tarsus with segments 1-4 bearing ventral tufts of fine hairs. Thoracic villosity white. Hind tibia bicarinate, basal carina bearing ciliae longer and paler than those of distal carina; spurs slender, blunt, smaller spur less than half length of larger; tarsus with segment 1 longitudinally grooved, segment 5 with a strong ventral notch.

Abdomen with sparse erect hairs only across middle; pygidium vertical, scarcely convex, slightly compressed at sides; disc with close shallow irregular transversely distorted punctures, bearing short white depressed hairs, and longer erect yellowish hairs near margins. Genitalia as in Figure 155.

♀. Unknown.

*Type locality*.—Bundaberg, Qld.

*Specimens examined*.—Holotype ♂, "Bundaberg, 30.11.27, K58172, C.22. *Amblyterus*, id. by A. M. Lea"; paratype ♂, ditto "G. Bates" (AM).

## 7. *AMBLYTERUS TIBIALIS*, sp. nov.

Figs. 140, 143, 150, 156

Very closely related to *bundabergensis*, differing in the following respects:

♂. Length slightly greater (c. 15 mm); labrum more distinctly concave in profile; antennal club somewhat broadened distally, distinctly shorter than shaft; clypeus (Fig. 140) more evenly rounded; pronotum (Fig. 143) without micropunctures, basal ridge obsolete across median third; apical half of scutellum impunctate; fore tibia (Fig. 150) broader, with proximal tooth c. half height of median tooth; smaller hind tibial spur slightly more than half length or longer; broad carina bearing ciliae of same type as distal; hind tarsal segments 1-4 longitudinally grooved; abdomen with decumbent hairs, in addition to erect hairs, across middle. Genitalia as in Figure 156.

♀. Unknown.

*Type locality*.—"Australia".

*Type location*.—ZM.

*Specimen examined*.—Holotype ♂, "Australia" (ZM).

Two further species of *Amblyterus* are represented by unique specimens in the collection of the Queensland Department of Agriculture and Stock, but as these are damaged, they are not named. One, labelled "at light, Redland Bay, 11.11.35, A.R.B." (misidentified as *Saulostomus felschei* Ohaus) may be related to *deuqueti*, and is distinctive in having the head, pronotum, and sides of the elytra clothed with dense erect reddish brown hair; the maxillary sensoria are superficial and the tarsi apparently untoothed. The second species is labelled "S. Isis, H. Tryon"; it is more characteristic of the genus, but differs in a number of small characters from any of the species discussed above.

### Tribe ADORETINI Ohaus

Adoretini Ohaus, 1912, Dtsch. ent. Z. **1912**: 141; 1914, op. cit. **1914**: 471; 1918, Col. Cat. Junk **20**(66): 182; 1934, Gen. Ins. **199A**: 4.

### Subtribe ADORETINA Ohaus

Adoretina Ohaus, op. cit.

### Genus ADORETUS Laporte

*Adoretus* Laporte, 1840, Hist. Nat. Col. **2**: 142.

This genus is represented on the Australian continent by a single species from the Northern Territory. This species may be distinguished immediately from all other endemic rutelines by the form of its labrum. This segment is produced to form a curved process overlying the apex of the mentum; its dorsal surface bears one or two transverse rows of small denticles.

### 1. ADORETUS MELVILLENSIS Lea

*Adoretus melvillensis* Lea, 1919, Trans. Roy. Soc. S. Aust. **43**: 246, pl. 27, fig. 78.

Small species 10–12 mm in length, varying in colour from a light brownish yellow to almost black; dorsal surface clothed with short white decumbent hairs; clypeus very broad, eyes prominent.

♂. Mentum strongly recurved at apex, overlaid by labrum; the latter with a row of denticles transversely across middle, and a second row adjacent to ventral margin. Palps small, terminal segment of maxillary palp tapering, with a superficial dorsal sensorium. Mandibles with apices bent ventrally. Antenna 10-segmented, club slightly shorter than slender shaft, longer than mid length of clypeus.

Clypeus broad, transverse, sides diverging for a very short distance, then angulate and rounded across front, the margin strongly and evenly recurved. Head bearing greyish yellow setae, longest and most conspicuous near margin. Clypeo-frontal suture transverse; ocular canthi slender, with pale brown hairs. Frons broad.

Pronotum highly transverse, marginal ridges continuous, sides rounded, anterior angles subacute, basal angles obtuse; disc bearing distorted punctures and recumbent white hairs, its surface microreticulate. Scutellum and elytra similarly clothed.



Epipleurae defined by narrow ridges, non-membranous, setose almost to apices, the latter truncate; calli scarcely discernible.

Fore tibia strongly 3-dentate, the teeth equidistant and crowded into distal half of segment; tarsus slender, with segment 1 equal in length to segments 2-4 together, slightly shorter than segment 5. Claws long, slender, simple. Prosternal process small, tapering, setose. Thorax and abdomen with short white decumbent hairs. Hind legs slender, tibia bicarinate, spurs slender, subequal in length, separated by a single cilia. Claws of middle and hind legs very unequal in length, simple.

Pygidium subvertical, moderately convex in profile, evenly clothed, micro-rugulose, apex rounded and with ridge broadened in middle; middle of last sternite slightly truncated.

♀. Antennal club shorter than mid length of clypeus. Fore tarsus with segment 1 as long as segment 5. Claws simple. Labrum with transverse median row of denticles, but lacking marginal row. Pygidium sloping, almost flat in profile, with apical margin not broadened in middle, and last sternite not at all truncated.

Lea claimed that the larger anterior claws of the female are slightly cleft, but no trace of this is discernible in the three females examined.

*Type locality*.—Melville I., N.T.

*Type location*.—SAM (W. D. Dodd, Type I 4854).

*Specimens examined*.—1 ♂, 1 ♀ cotype, "Roper R., N.T., W. McLennan 4.16" (NM); type ♂, "Melville Is.", ♂, "King R., N.T. 24.12.15.", 2 ♀♀, "Roper R., N.T., 3.3.16" (SAM).

*Distribution*.—NORTHERN TERRITORY: Melville I., King R., Roper R.

## V. ACKNOWLEDGMENTS

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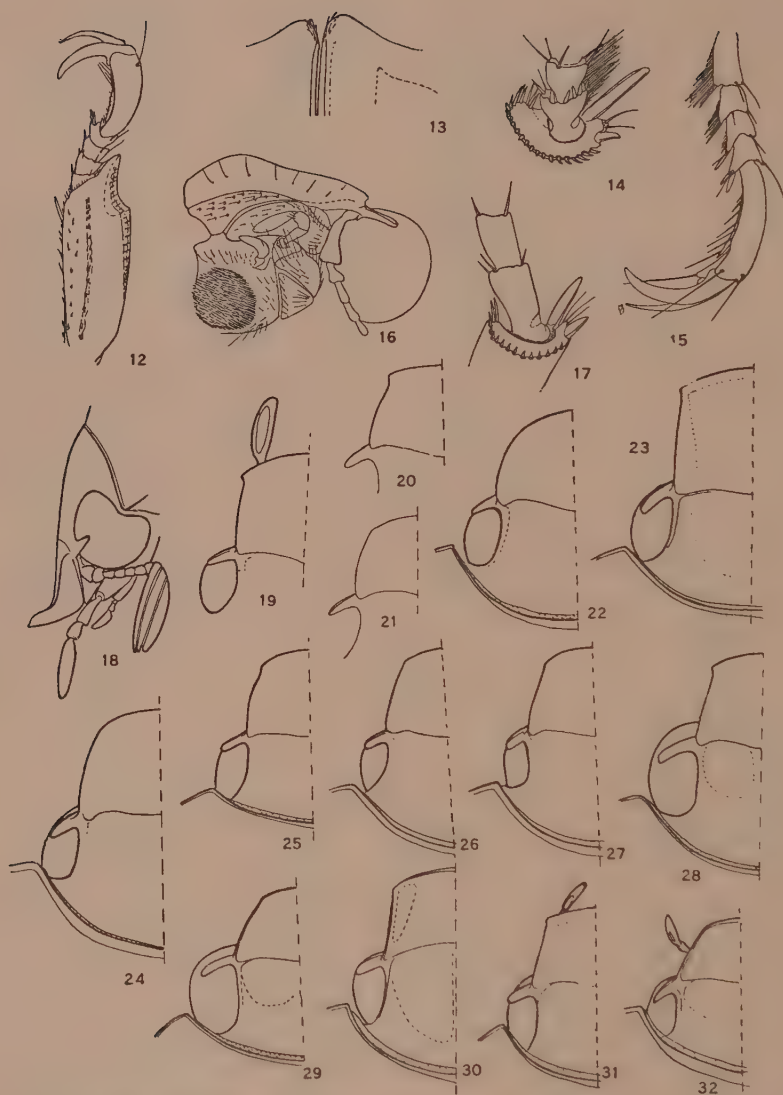
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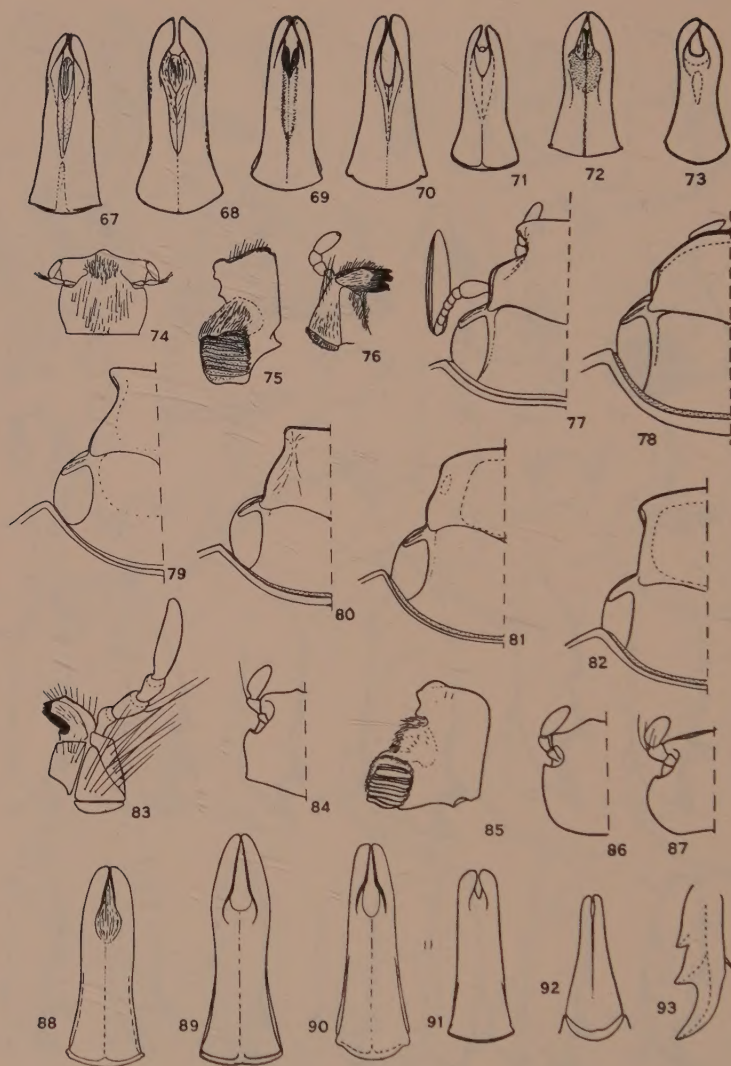


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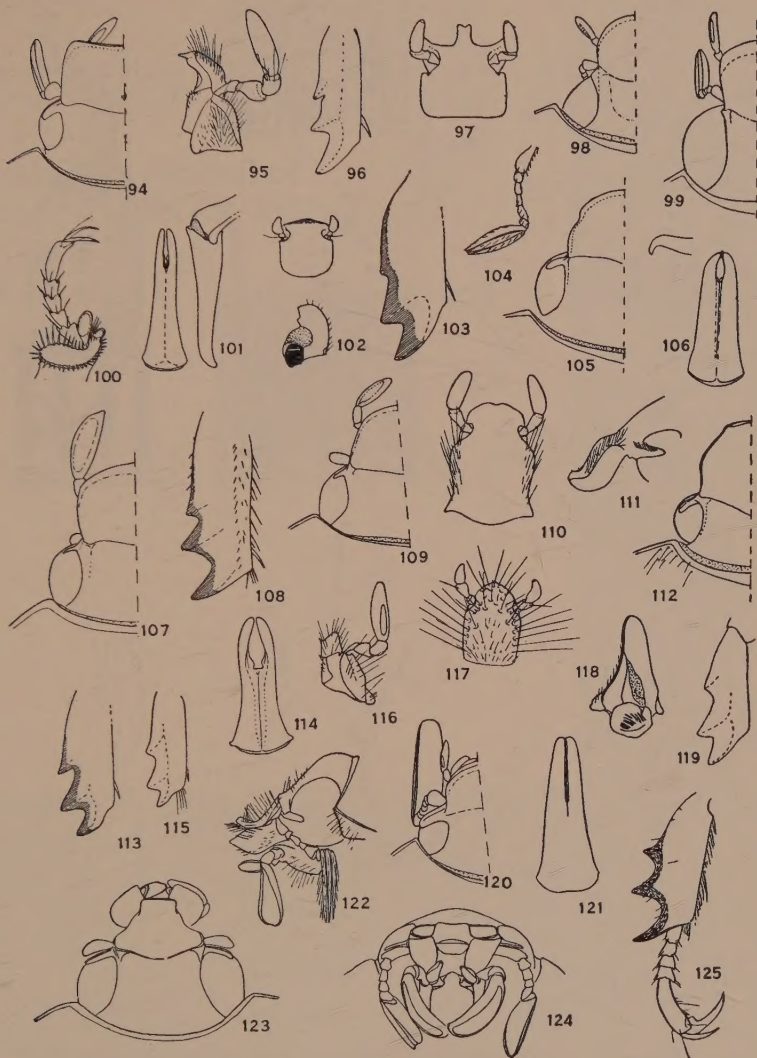


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